CHAPTER 11. MANUFACTURER IMPACT ANALYSIS

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CHAPTER 11. MANUFACTURER IMPACT ANALYSIS

11.1 MANUFACTURER IMPACT ANALYSIS METHODOLOGY

In determining whether a standard is economically justified, the Secretary of Energy is statutorily required to consider "the economic impact of the standard on the manufacturers and on the consumers of the products subject to such a standard."[a] The legislation also calls for an assessment of the impact of any lessening of competition as determined in writing by the Attorney General. The purpose of the Manufacturer Impact Analysis (MIA) is to provide information that can be used to evaluate these impacts. The MIA estimates the financial impact of standards on manufacturers and reports impacts on employment and manufacturing capacity.

Prior to initiating the detailed MIA for the clothes washer rule making, the U.S. Department of Energy (DOE) prepared an approach document titled "Clothes Washer Manufacturer Impact Analysis." This document was presented at a public workshop held on December 14-15, 1998. It was based on the general framework for the MIA presented by the Department at a workshop in March 1997 and was modified for its application to the clothes washer rule. The approach document outlined procedural steps and identified issues for consideration.

As proposed in the approach document, the MIA was conducted in three phases. Phase 1, "Industry Profile," consisted of the preparation of an industry characterization. Phase 2, "Preliminary Industry Cash Flow," had as its focus the larger industry. In this phase, the Government Regulatory Impact Model (GRIM) was used to prepare a preliminary industry cash flow analysis. Here, the Department used publicly available information developed in Phase 1 to adapt the GRIM structure to facilitate the analysis of new clothes washer standards. In Phase 3, "Sub-Group Impact Analysis," the Department discussed fully the results of the Preliminary Industry Cash Flow analysis with each manufacturer and identified the differing impact of standards on sub-groups of manufacturers. Phase 3 also entailed documenting additional impacts on employment and manufacturing capacity through a structured interview process.

11.1.1 Phase 1: Industry Profile

Phase 1 of the MIA consisted in preparing an Industry Profile. Prior to initiating the detailed impact studies, DOE received input on the present and past structure and market characteristics of the clothes washer industry. This activity involved both quantitative and qualitative efforts to assess the industry and products to be analyzed. Issues addressed included manufacturer market shares and characteristics, trends in the number of firms, the financial situation of manufacturers, and trends in clothes washer characteristics and markets.

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[a] The Department of Energy's appliance standards program is conducted pursuant to Title III, Part B of the Energy Policy and Conservation Act (EPCA). 42 U.S.C. 6291-6309.

The industry profile included a top-down cost analysis of the appliance industry that was used to estimate the disaggregated costs of a baseline clothes washer. The cost structure was used to derive cost and financial inputs for the GRIM-e.g., material, labor, overhead, depreciation, sales general & administration (SG&A), and research & development (R&D). The profile was also instrumental in estimating the manufacturer and retail mark-ups that were used in the Life-Cycle Cost Analysis.

Publicly-available quantitative data published by the U.S. Bureau of Census with regards to the clothes washer industry is included in Chapter 3. The chapter includes information on the number of companies, number of manufacturing establishments, and industry employment, payroll, value added, cost of materials consumed, capital expenditures, product shipments, and concentration ratios.

The Department also utilized additional sources of information to further characterize the clothes washer industry. These include company Securities and Exchange Commission (SEC) 10-K and annual reports, Moody's company data reports, Standard & Poor's (S&P) stock reports, Value Line industry composites, and Dow Jones Financial Services.

11.1.2 Phase 2: Preliminary Industry Cash Flow Analysis

A change in standards affects the analysis in three distinct ways. Increased levels of standards will require additional investment, raise production costs, and affect revenue through higher prices and, possibly, lower quantities sold. To quantify these impacts the Department performed in Phase 2 an industry cash flow analysis using the GRIM.

For the Preliminary Industry Cash Flow Analysis, DOE prepared a list of financial values for the GRIM industry analysis. These were calculated by studying publicly- available financial statements of clothes washer manufacturers. A detailed definition of financial inputs and their values for a "prototypical" clothes washer manufacturer is presented in section 11.2. Values for currently sold "Base Case" prices were derived from the Bureau of Census's Current Industrial Reports (CIRs). The dollar value of clothes washer shipments from factories is divided by the quantity of clothes washers shipped to arrive at the per-unit manufacturer price. In order to estimate manufacturing costs-labor, materials, depreciation/tooling, etc.-from the average manufacturer prices obtained from the CIRs, a typical clothes washer industry cost structure was developed using publicly-available information from the Census of Manufacturers (CMs) and from industry statistics obtained from SEC-10K reports. Finally, in preparing the Preliminary Industry Cash Flow Analysis, DOE used the same clothes washer shipment scenarios developed for the National Energy Savings (NES) spreadsheet.

11.1.3 Phase 3: Sub-Group Impact Analysis

DOE conducted detailed interviews with clothes washer manufacturers representing over 99 percent of domestic clothes washer sales to gain insight into the potential impacts of standards on their revenues and finances, direct employment, capital assets and industry competitiveness, and to solicit the information necessary to validate industry cash flows.

The interview process played a key role in the MIA, since it allowed manufacturers to privately express their views on important issues and to provide confidential information needed to assess financial, employment, and other business impacts. To verify the assumptions used to derive the Preliminary Industry Cash Flow, an interview guide solicited information on the possible impacts of new standards on manufacturing costs, product prices, and sales. Each manufacturer was provided a version of the GRIM that included shipment forecasts at each efficiency level, baseline prices and costs of the V-axis and H-axis washers, and incremental product costs for all percentiles reported by AHAM. In preparation for the interview, each manufacturer could, if desired, input its own data and assumptions to develop its own expected cash flow. Alternatively, manufacturers could select the percentile values that best represented their costs at different efficiency levels. During the interviews, DOE discussed with each manufacturer the differences, if any, between the impact of energy-efficiency standards on their shipments, prices, costs, and associated margins and those presented in the sample results for the industry as a whole.

The interview guide solicited both qualitative and quantitative information. Supporting documentation was requested wherever applicable. Interview participants were asked to identify all confidential information provided verbally or in writing. Approximately two weeks following the interview, an interview summary was provided to the manufacturers to give them an opportunity to confirm the accuracy and protect the confidentiality of all the collected information. The manufacturer interview guide is presented in Appendix O.

11.1.4 Small Manufacturer Sub-Group

Using industry "average" cost values is not adequate for assessing the variation in impacts among sub-groups of manufacturers. Comments received following the publication of the preliminary Technical Support Document indicated that the smaller manufacturers of clothes washers could be more negatively affected than other manufacturers by any proposed standard. To assess the potential impacts of possible washer standards on smaller manufacturers, DOE conducted preliminary interviews with the three smallest clothes washer manufacturers (by market share) and held discussions on possible approaches to performing the Manufacturer Impact Analysis for small manufacturers. DOE and the manufacturers discussed how a small-manufacturer GRIM could be constructed and contrasted with the industry cash flow analysis. Foremost in the discussions were issues concerning data collection and aggregation and the ensuing confidentiality concerns given the small group of manufacturers and their unbalanced size.

All of the smaller manufacturers worked with DOE to develop a company-specific GRIM analysis for their firms. Even within the small manufacturer sub-group, DOE found significant differences in financial structure among the firms depending on their business models (e.g., OEM vs. retail emphasis, product market niche). DOE found that from a financial standpoint the common characteristic of this group, in contrast to the overall industry, was its need to spread fixed costs over smaller production volumes. During the interviews, small manufacturers demonstrated that several of the key costs necessary to meet any new regulation are largely independent of the product volume produced. The most apparent are the costs necessary to design a new product meeting the proposed energy standards. Other costs, such as plant engineering, some tooling, and other capital costs, have significant portions that are independent of final production volumes.

To assess the "differential" potential impacts of possible washer standards on smaller manufacturers without revealing individual manufacturers' proprietary information, DOE prepared a cash flow analysis of the potential effects on a "prototypical" smaller manufacturer. The basic approach to analyzing the economic effects on a smaller manufacturer involved determining the smaller company's fixed cost structure relative to the industry average and the likely ability of the smaller company to recover its full costs and investments after implementation of a new standard.

Dryer Analysis. An important consideration regarding new efficiency standards that came to light during the course of interviews with manufacturers, was the pull-through effect of clothes washers on the clothes dryer market. The majority of manufacturers indicated that stringent standards on clothes washers would have an effect on dryers since dryer sales are highly correlated to washer sales as the two are frequently bought as a set. A separate cash flow analysis was prepared in an effort to model the financial impact of these considerations on the dryer business. The Dryer GRIM analysis is incorporated in the GRIM Model.

Impact on Clothes Washer Repair Industry**.** Should an increase in energy efficiency standards result in higher prices for new clothes washers, consumers may be influenced to repair old units rather than purchase new ones at the higher price. Based on the forecast of clothes washer repairs, the Department estimated the impact of a change in clothes washer repair revenues on the NPV of the clothes washer manufacturers’ repair parts business. Those impacts are calculated and incorporated in the GRIM Model.

11.2 INPUTS TO THE GRIM

11.2.1 Overview of GRIM Spreadsheet

The GRIM was used to evaluate the cash flow impacts of regulations on the clothes washer industry. The basic structure of the GRIM, illustrated in Figure 11.1, is a standard annual cash flow analysis that uses manufacturer price, manufacturing costs, shipments, and industry financial information as an input and accepts a set of regulatory conditions as changes in costs, investments, and associated margins.

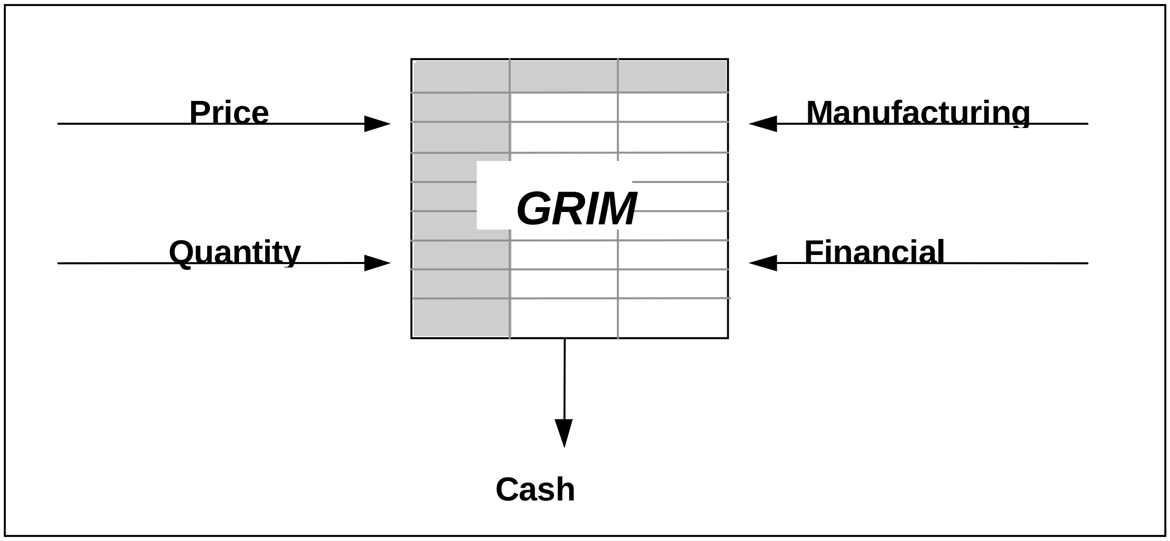

Figure 11.1 Using GRIM to Conduct the Cash Flow Analysis

The GRIM spreadsheet uses a number of factors-annual expected revenues, cost of sales, selling and administration costs, taxes, changes in working capital, and capital expenditures related to new standards-to arrive at a series of annual cash flows, beginning from the base year of the analysis and continuing explicitly for several years after the implementation of the standard. The measure of industry net present value (NPV) is calculated by discounting the stream of annual cash flows.

The GRIM calculates cash flows by year and then determines the present value of those cash flows, both without regulations (Base Case) and with regulations (Standard Case), using the appropriate discount rate. For the purpose of this analysis, the Base Case scenario represents the business scenario in the absence of a standard. If a new clothes washer standard comes into effect, it will change the product mix of clothes washers being sold in the market and their associated prices, costs, and shipments. Such a scenario is called the Standard Case scenario. Hence, Base Case NPV implies the present value of cash flows in the absence of a standard; Standard Case NPV implies the present value of cash flows in the scenario where a standard comes into effect. To project future cash flows, the clothes washer GRIM analysis assumes 2001 as the announcement year of the standard and 2004 as the year when the new standard will come into effect.

The following sections present the inputs used in the industry GRIM. These are:

- 11.2.2 Financial Inputs
- 11.2.3 Shipments
- 11.2.4 Manufacturing Costs

11.2.2 Financial Inputs to the GRIM

DOE developed an initial industry characterization using information from relevant industry and market publications, industry trade organizations, company financial reports, and product literature. This industry characterization provided the inputs that were used to develop a preliminary industry cash flow analysis.

The financial reports of the five major U.S. clothes washer manufacturers were studied. The top three clothes washer manufacturers by market share, namely, Whirlpool, Maytag and General Electric, together accounted for 88 percent of all clothes washers manufactured in the U.S. in the year 1996. For Whirlpool and Maytag, home appliance manufacturing represents the major portion of their business and revenue generation. Hence financial data obtained from a top-down analysis of their SEC 10-K reports would be representative of the clothes washer industry (assuming that clothes washers are a microcosm of the total major appliance industry).

GE, however, is highly diversified, and its appliance manufacturing business-GE Appliance-accounted for only a small percentage (8%) of GE's total revenues in 1996. Similarly Amana (which was a part of Raytheon until recently when it was sold to Goodman Holdings) accounted for only about 12 percent of Raytheon's annual sales (and 6 percent of the profits). Hence, like GE, the information obtained from Raytheon's SEC 10-K reports may not be representative of its appliance manufacturing business (i.e., of Amana's financial structure).

Frigidaire is a subsidiary company of Electrolux AB, a European company. Electrolux is the world's largest manufacturer of household appliances, such as white goods, vacuum cleaners and outdoor products. Most of Electrolux's revenues come from operations outside North America (59% from Europe, 6% from Asia, and 6.4% from Latin America) and hence financial data from Electrolux's income statements may not be indicative of the business environment in North America. Also, differences in accounting principles for financial reporting purposes (between U.S. and other countries) might lead to a different financial structure.

Value Line and Standard & Poor's (S&P) composite industry statistics for the home appliance industry were reviewed. Value Line's statistics for the home appliance industry are a composite of the following companies: Whirlpool, Maytag, Fedders Corp., Black & Decker, Toro, and National Presto Industries. In S&P reports, appliance manufacturers are included in the "Household Furnishings and Appliance" industry. The S&P statistics are a composite of the following companies: Armstrong World, Basset Furniture, Fedders Corp., Maytag, Mohasco, Roper, Rubbermaid, Whirlpool, White Consolidated Industries, and Zenith Electronics. Given the composition of the industry-composites, Value Line's industry statistics are possibly more representative of the clothes washer industry.

The financial inputs to the GRIM are described below. Historical shipments, market share and market characteristics incorporated in the development of the GRIM analysis are presented in Chapter 3.

11.2.2.1 Tax Rate

Firms pay an annual tax, levied by the Federal and state governments, based on income. Taxable income and the income taxes paid are presented as separate line items in a company's income statement. Table 11.1 presents the effective income tax rates for two major appliance manufacturers over the period 1990-96. It also presents the industry average tax rate which is obtained by weighting effective income tax rates of four clothes washer manufacturers by their clothes washer shipments. This information was obtained from the manufacturers' income statements, by dividing the income taxes paid by the taxable income. The tax rate for the industry composite, as reported by Value Line, is in close agreement with that for the industry average. The Department proposes using an income tax rate of 42.8% as an input to GRIM. This value is based on the industry average tax rate.

Table 11.1 Average Income Tax Rates

Manufacturer	Avg. Tax Rate (1990-1996)
A	46.5%
B	45.4%
Industry Average	42.8%
Value Line	40.0%

11.2.2.2 Working Capital

Working capital is defined as the difference between a firm's short-term (or current) assets and short-term (or current) liabilities, where the current assets and liabilities are obtained from the firm's annual balance sheets. It is the part of a company's capital that must be maintained in order to undertake day-to-day operations of the company without experiencing liquidity problems.

Table 11.2 presents average working capital maintained by two major appliance manufacturers as a percentage of their annual revenues. Data has been averaged over the period 1990-96. Working capital data is also presented for the home appliance industry composite as reported by Value Line.

Clearly there exists considerable variability in the working capital requirements of various firms based on information obtained from SEC 10-K reports. In general, companies will strive to lower their working capital needs to the lowest amount possible so as to free up as much cash flow as possible for revenue-generating investing activities. Discussions with appliance industry analysts indicate that working capital requirements are in the 7-16% range. Based on this information, the Department assumed working capital to be 10.50% of revenues for input into GRIM.

Table 11.2 Average Working Capital as a Percentage of Revenues

Manufacturer	Working Capital as % of Revenues (1990-96)
A	(0.70)
B	16.09
ValueLine	6.76

11.2.2.3 Selling, General and Administration (SG&A)

Table 11.3 presents average SG&A expenses for two major appliance manufacturers as a percentage of their annual revenues. The data has been averaged over seven years, 1990 through 1996. SG&A information is presented as a line item in individual manufacturers' income statements, presented in separate SEC 10-K reports.

Selling costs include any expense or class of expense incurred in selling or marketing. In a manufacturing firm, selling costs include both marketing costs and logistics (order-filling) costs. Marketing costs include market research, advertising, point-of-sale promotions, and salespersons' compensation and travel costs. Logistics costs include warehousing and delivery costs as well as record-keeping costs associated with processing an order. General and Administrative (G&A) costs are expenses incurred for the general direction of the enterprise. G&A costs include the cost of service and staff units (such as the personnel office) and general corporate costs, including compensation of top management and donations to charitable organizations. The Department used a value of 18.0% (revenue weighted average of the two manufacturers in Table 11.3) of revenues for SG&A expense as an input to GRIM.

Table 11.3 Average SG&A Expense as a Percentage of Revenues

Manufacturer	**SG&A as % of Revenues (1990-96)**
A	18.43
B	17.01

11.2.2.4 Research and Development (R&D)

Research and development (R&D) costs are costs incurred for the purpose of developing new or improved goods, processes or services. The results of R&D efforts are increased revenues or lower costs. Table 11.4 presents the R&D costs incurred by two major appliance manufacturers as a percentage of their annual revenues. The R&D cost data has been averaged over the past four years, 1993 through 1996. Data for the period 1990-1992 is not available as the separate disclosure of research and development expense is a relatively recent requirement. Formerly, most companies included this expense as a part of general and administrative expenses. Because the amount spent on research and development can provide an important clue as to how energetic the company is in keeping its products and processes up to date, FASB requires that this amount be reported separately if it is material.

Based on the information in Table 11.4, the Department used a value for R&D expense of 1.80% (revenue weighted average of the two manufacturers in Table 11.4) of revenues for input into GRIM.

Table 11.4 Average R&D Costs as a Percentage of Revenues

Manufacturer	Avg. R&D Cost as % of Revenues (1993-96)
A	2.01
B	1.50

11.2.2.5 Depreciation

Plant and manufacturing equipment assets have limited useful lives; that is, they will provide service to the firm over a limited number of future accounting periods. A fraction of the cost of these assets is therefore properly chargeable as expense in each of the accounting periods in which the assets provide service to the firm. The accounting process for this gradual conversion of plant and equipment capitalized cost into expense is called depreciation. Table 11.5 presents average depreciation expense for two major appliance manufacturers as a percentage of their annual revenues. The data has been averaged over seven years, 1990 through 1996. Depreciation is presented as a separate line item in the manufacturers' income sta tements as presented in SEC 10-K reports.

Based on information in Table 11.5, the Department proposes using depreciation expense as 3.51% (revenue weighted average of the two manufacturers) of revenues for input into GRIM.

Table 11.5 Average Depreciation Expense as a Percentage of Revenue

Manufacturer	**Depreciation as % of Revenues (1990-96)**
A	3.54
B	3.43
ValueLine	3.66

11.2.2.6 Capital Expenditures

These are the expenditures made for additions to fixed assets, like plant, equipment, etc.,intended to benefit future accounting periods (in contrast with other expenditures that benefit the current period). These expenditures are aimed at increasing the capacity, efficiency, life span, or economy of the operation of an existing fixed asset, or, in some cases, to build entirely new assets.

Table 11.6 presents average capital expenditures for two major appliance manufacturers as a percentage of their annual revenues. The data has been averaged over seven years, 1990 through 1996. The Department used a value of capital expenditures of -3.90 % as an input into GRIM. Although initially DOE proposed to use -4.43% (revenue weighted average of the two manufacturers in Table 11.6) as an input into GRIM, this figure was lowered to -3.90% to reflect the lower shipment growth forecast compared to the earlier GRIM and to calibrate return on invested capital for the base case.

Table 11.6 Average Capital Expenditures as a Percentage of Revenues

Manufacturer	Capital Expenditures as % of Revenues (1990-96)
A	4.47
B	4.33

11.2.2.7 Cost of Capital/Discount Rate

Cost of capital is a measure of a company's cost of using capital that it raises either through loans (i.e., debt) or by issuing equity. It is the minimum rate of return that must be earned on new investments that will not dilute the equity of the shareholders. This rate of return is often referred to as the discount rate, hurdle rate, or the opportunity cost of capital. The company cost of capital is a weighted average of the returns that investors expect from various debt and equity securities issued by the firm. It is calculated as the cost of debt capital (which is then adjusted for the income tax effect of debt financing) plus the cost of equity capital, weighted by the relative amount of each in a company's capital structure. For the purpose of characterizing financial impacts of regulations on manufacturers using GRIM, the Department used the company cost of capital to discount future cash flows for arriving at the clothes washer industry

In order to calculate the company cost of capital, it is essential to identify a company's cost of raising debt, cost of raising capital through issuing equity, and the capital structure of the company. The capital structure of a company gives information about the amount of debt versus the amount of equity in the company.

Cost of debt. Cost of debt is a weighted average cost of debt based on all forms of debt financing outstanding. Information on the amount of debt outstanding and the interest rate at which it was issued was obtained from SEC 10-K financial statements and Moody's reports for two publicly traded appliance manufacturers.

Table 11.7 presents the nominal cost of debt and debt ratios for two appliance manufacturers. The cost of debt is calculated in two ways:

(A) As the weighted average cost of all debt based on the coupon yield, which is the yield that a company promises to pay on a bond's face value at the time of issuance of the debt. This weighted average represents a company's nominal cost of debt capital from the time it issued the debt to the present time.

(B) As the weighted average cost of all debt based on yield to maturity. Yield to maturitydetermines the rate of return an investor will receive today if a long-term bond is held to its maturity date. This yield represents the nominal cost of debt to a company if it needs to raise debt capital at the present time.

Table 11.7 presents cost of debt estimates using both approaches (a) and (b). While regulators often use an average stated actual cost of debt (as calculated in approach (a)) to determine cost of debt, it is preferable to use the current replacement cost of debt (market value of debt as calculated by approach (b)) for calculating the cost of capital for the purpose of assessing the present value of the future cash flows or for evaluating alternative investment proposals of financial policies if the policies or proposals involve debt financing. Cash flows associated with new investments should be matched with the current or prospective cost of all capital associated with such investments. Debt ratio is defined as the ratio of long-term debt to total long-term capital (i.e., long-term debt plus equity), and illustrates a company's capital structure.

Table 11.7 Cost of Debt and Debt Ratio

Manufacturer	Cost of debt (Coupon Yield)	Cost of debt (Yield to Maturity)	Debt Ratio (1990-96)
A	8.27	6.92	0.38
B	9.01	7.07	0.49

The real cost of debt is obtained by adjusting the nominal value for inflation. Average annual inflation in the U.S. over the period 1990-96 was 3.42%, and more recently, it was 2.2% in the year 1997.[a] For Manufacturer A, 8.27% represents the average nominal cost of debt that it raised through corporate bond offerings at different points in time over the past 10 years, a time frame during which the interest rates and inflation rates have been varying; whereas, 6.92% represents the nominal cost

[a]Nominal cost implies that the cost has not been adjusted to take account of inflation.

of debt if Manufacturer A raised its debt in 1997 when both interest rates and inflation were low. In the long run, for raising debt required to meet regulations, it could be assumed that Manufacturer A's nominal cost of debt would fall between 7% and 9% provided there are no sharp changes in interest rates. The same argument holds for Manufacturer B, which would also be able to raise debt at the 7-9% nominal rate. According to Statements of Management Accounting, cost of debt based on yield to maturity would provide a better estimate. However, it is difficult to estimate the exact costs at which these companies could raise debt at some point of time in the future.

Another way of looking at corporate debt rates is by treating them as spreads (basis points) over the Treasury bill rates. Both manufacturers have similar bond ratings (Baa1 as provided by Moody's). Looking at historical annualized return spreads for corporate bonds, both manufacturers, with their Baa1 ratings, would be able to raise 30-year debt instruments at approximately 120 basis points above U.S. Treasuries.[a] Looking at current interest rates, this would mean a nominal cost of debt in the range of 7.3% for 30-year debt instruments. Adjusting for an inflation rate of 2.2% in 1997, the real cost of debt would be around 5%.

Ibbotson Associates, a company that publishes industry specific financial information on a quarterly basis, reports a nominal cost of debt of 7.14% for the home appliance industry for the year 1997. The July 1991 AHAM report, entitled "Financial Impact of DOE Top Loading Horizontal Axis Standards on Washing Machine Manufacturers," used a nominal cost of debt of 9.2%. Adjusting for inflation (2.2% in 1997 and 4.2% in 1991), the real costs of debt as reported by Ibbotson Associates and the AHAM report would be 4.94% and 5.0%, respectively.

Based on arguments above, the Department used 5% as the real cost of debt.

Cost of equity. Cost of equity is the rate of return that equity investors expect to earn on their investments in a company's stock. These expectations are reflected in the market price of the company's stock. One way of estimating the cost of equity is by using the capital asset pricing model (CAPM). The CAPM is based on the premise that the expected or the required rate of return on any firm's common stock equals the riskless rate of interest plus a premium for risk. The CAPM is widely used by large corporations to estimate their costs of equity.[b]

According to the CAPM, the cost of equity, or, the expected return for equity, is determined as:

cost of equity = riskless rate + beta * [risk premium]

where:

[a]Used with permission. ©1998 Ibbotson Associates, Inc. All rights reserved. [Certain portions of this work were derived from copyrighted works of Roger G. Ibbotson and Rex Sinquefield.]

[b]For more information on CAPM the readers are referred to Chapters 7,8 and 9 of Corporate Finance by Brealy, R.A., and Myers, S.C.; and to article entitled Does capital asset pricing model work by Mullins, D.W., published in the Harvard Business Review.

- riskless rate is usually the short-term Treasury bill rate, or the long-term government bond rate adjusted for the risk premium over Treasury bills,
- risk premium is the difference between the expected return on the market portfolio and the riskless rate, and
- beta is a measure of the sensitivity of a company's stock to market movements.

Table 11.8 presents yields on Treasury bills and government bonds, and the average risk premium associated with these securities. Each portfolio offers different degrees of risk. Treasury bills are about as safe an investment as one can make. There is little risk of default, and their short maturity means that the prices of Treasury bills are relatively stable. However, investors cannot lock in a real rate of return; there is still some uncertainty about inflation. By switching to long-term government bonds, investors acquire an asset whose prices fluctuate as interest rates vary. (Bond prices fall when interest rates rise and rise when interest rates fall.) An investor who switches from government bonds to common stocks has a direct share in the risks of the enterprise, and hence accepts the additional default risk. Investors who accepted the extra risk of common stocks received, on average, a premium of 8.5% a year over the return on Treasury bills.

Table 11.8 Average Rates of Return (1990-96) and Risk Premiums (1926-94) on Some Securities (figures in percent per year)

Portfolio	Average Annual Rate of Return (Nominal) (1990-96)[a]	Average Risk Premium (Extra return vs. Treasury bills) (1926-94)[b]
Treasury bills	5.00	0
Government bonds(10 yr.)	7.06	1.5
Common stocks (S&P 500 index)		8.5

Table 11.9 presents average values of beta for two appliance manufacturers. The data has been averaged over the period 1991-96. The values of beta are obtained from financial services provided by the Dow Jones Company. They measure the sensitivity of a stock's price to overall fluctuations in the S&P 500 stock index. Beta measures the sensitivity of the return on an individual stock to the return on the market portfolio. A stock with a beta of 1 tends to move up and down in the same percentage as the market. Stocks with a beta coefficient less than 1 tend to move in percentage terms less than the market. Similarly, a stock with a beta that is higher than 1 will tend to move up and down more than the market.

[a]Based on data from the Federal Reserve Statistical Release.

[b]Used with permission. ©1998 Ibbotson Associates, Inc. All rights reserved. [Certain portions of this work were derived from copyrighted works of Roger G. Ibbotson and Rex Sinquefield.]

Table 11.9 Average Beta Values for Two Appliance Manufacturers

Manufacturer	Beta (1991-96)
A	0.94
B	0.90

Using CAPM to calculate the cost of equity, the following results are obtained for two appliance manufacturers:

Manufacturer A: Cost of equity = (7.06-1.5) + 0.94 * (8.5) = 13.55 %
[riskless rate] beta * [risk premium]

Manufacturer B: Cost of equity = (7.06-1.5) + 0.90 * (8.5) = 13.21 %
[riskless rate] beta * [risk premium]

Adjusting for inflation (averaging 3.42% per year over the period 1990-96), the real cost of equity for Manufacturer A is 10.13% and for Manufacturer B is 9.79%.

Weighted Average Cost of Capital (WACC) is defined as:

WACC = (1-tax rate) * cost of debt * [debt/(debt+equity)] +cost of equity * [equity/(debt+equity)]

Manufacturer A: WACC = [(1-0.465) * 5.00 * 0.38] + [10.13 * (1-0.38)] = 7.30%

Manufacturer B: WACC = [(1-0.454) * 5.00 * 0.49] + [9.79 * (1-0.49)] = 6.33%

The weighted average cost of capital calculated accounts for inflation, as real values of cost of equity and debt are used in the calculation. In calculating WACC it is assumed that the two manufacturers maintain the same capital structure in the future, i.e. future debt ratios are the same as those in the past (see Table 11.7).

Independent estimates of the WACC were obtained from Ibbotson Associates, a company that tracks the industry cost of capital for over 300 industries. Their analysis reports a WACC of 11.6% for the household appliance industry (represented by the SIC code 363) in the year 1997. Adjusting for inflation (2.2% in 1997), the WACC net of inflation would be 9.4%. This analysis is a compositeof eight companies: Whirlpool Corporation, Maytag Corporation, Royal Appliance Manufacturing Company, National Presto Industries Inc., Rival Company, Health O Meter Products Inc., Salton/Maxim Housewares Inc., and Windmere-Durable Holdings.

The July 1991 AHAM report used a cost of debt of 9.2% (bond rate) and a cost of equity of 13% based on average return on equity earned by the Standard and Poor's 500 Industrial Average in

1990. Adjusting for tax effects and using a typical capital structure, the AHAM report calculated a total cost of capital of 10% before inflation. Adjusting for inflation (which was 4.2% in 1991) the AHAM report used 6% as the discount rate for conducting industry cash flow analysis. Table 9.10 compares the cost of debt, cost of equity, and WACC calculated for manufacturers A and B to the household appliance industry composite values obtained from Ibbotson Associates and to the values used in the AHAM 1991 report.

Table 11.10 Comparison of Financial Data

Item	Manufacturer A	Manufacturer B	Ibbotson Associates Industry composite (1997)	AHAM 1991 Report
Cost of debt*	5.00	5.00	4.94	5.20
Cost of equity	13.55	13.21	15.87	13.00
Capital structure (Debt/Total value)	0.38	0.49	0.38	-
WACC*	7.30	6.33	9.40	6.00
Beta	0.94	0.90	0.85	6

*Values have been adjusted for inflation.

11.2.3 GRIM Shipments

The Department chose three shipment scenarios for the final cash flow analysis. Stakeholders consider these shipment scenarios to represent the full range of possible outcomes following a clothes washer standard. The three shipment scenarios are described below:

1. High Price Elasticity - Assumes consumers will react negatively to higher prices on clothes washers. This shipment scenario corresponds to the largest decrease in shipments because of standards. This scenario is very close to the shipment scenario used in the earlier version of the GRIM, which was reviewed by manufacturers.
2. Medium Price Elasticity - Assumes consumers will have a reaction to the higher prices of less magnitude than the high price elasticity scenario.
3. Medium Price/Income Elasticity - Assumes the price a consumer will pay is inversely related to their annual income. This scenario has the least impact on clothes washer shipments.

The following series of tables present the Base Case and Standard Case shipment forecasts for the years 1999 through 2020 for the three shipment scenarios. Shipments are given for trial standard levels presented in the NOPR.

Table 11.11 Clothes Washer Shipment Forecasts for the Base Case and Standard Case (High Price Elasticity Shipment Scenario)

Clothes Washer Shipments			(High Price Elasticity Shipment Scenario)					
	Baseline		*Trial Standard Level 1*		*Trial Standard Level 2*		*Trial Standard Level 4*	
			Eff. Improvement = 20%		*Eff. Improvement = 25%*		*Eff. Improvement = 35%*	
	Base Case	*MEF=.817*	*MEF=1.021*		*MEF=1.089*		*MEF=1.257*	
Year	*V-Axis*	*H-Axis*	*V-Axis*	*H-Axis*	*V-Axis*	*H-Axis*	*V-Axis*	*H-Axis*
	Shipment	*Shipment*	*Shipment*	*Shipment*	*Shipment*	*Shipment*	*Shipment*	*Shipment*
	million	*million*	*million*	*million*	*million*	*million*	*million*	*million*
1999	6.28	0.45	6.28	0.45	6.28	0.45	6.28	0.45
2000	6.32	0.49	6.32	0.49	6.32	0.49	6.32	0.49
2001	6.34	0.53	6.34	0.53	6.34	0.53	6.34	0.53
2002	6.34	0.56	6.34	0.56	6.34	0.56	6.34	0.56
2003	6.32	0.59	6.32	0.59	6.32	0.59	6.32	0.59
2004	6.34	0.63	6.21	0.62	5.83	0.58	0.00	5.62
2005	6.40	0.67	6.28	0.66	5.92	0.62	0.00	5.76
2006	6.49	0.72	6.38	0.70	6.03	0.67	0.00	5.94
2007	6.60	0.76	6.49	0.75	6.16	0.71	0.00	6.13
2008	6.70	0.81	6.59	0.80	6.28	0.76	0.00	6.33
2009	6.75	0.86	6.66	0.85	6.37	0.81	0.00	6.50
2010	6.82	0.91	6.73	0.89	6.47	0.86	0.00	6.71
2011	6.90	0.96	6.82	0.94	6.59	0.91	0.00	6.93
2012	6.97	1.00	6.90	0.99	6.69	0.96	0.00	7.14
2013	7.02	1.05	6.95	1.04	6.77	1.02	0.00	7.31
2014	7.05	1.10	6.99	1.09	6.83	1.06	0.00	7.46
2015	7.08	1.14	7.02	1.13	6.87	1.11	0.00	7.57
2016	7.08	1.19	7.02	1.17	6.85	1.15	0.00	7.56
2017	7.08	1.23	7.01	1.21	6.80	1.18	0.00	7.47
2018	7.10	1.27	7.00	1.25	6.75	1.21	0.00	7.36
2019	7.13	1.32	7.03	1.30	6.73	1.25	0.00	7.28
2020	7.18	1.37	7.06	1.35	6.75	1.29	0.00	7.28

Table 11.11 Clothes Washer Shipment Forecasts for the Base Case and Standard Case (High Price Elasticity Shipment Scenario) (Continued)

Clothes Washer Shipments					**(High Price Elasticity Shipment Scenario)**	
	Trial Standard Level 5		***Trial Standard Level 6***		***Trial Standard Level 3***	
	Eff. Improvement = 40%		***Eff. Improvement = 50%***		***Eff. Improvement = 21.4%/35.2%***	
	MEF=1.362		***MEF=1.634***		***MEF=1.04/1.26***	
Year	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***
	Shipment	***Shipment***	***Shipment***	***Shipment***	***Shipment***	***Shipment***
	million	*million*	*million*	*million*	*million*	*million*
1999	6.28	0.45	6.28	0.45	6.28	0.45
2000	6.32	0.49	6.32	0.49	6.32	0.49
2001	6.34	0.53	6.34	0.53	6.34	0.53
2002	6.34	0.56	6.34	0.56	6.34	0.56
2003	6.32	0.59	6.32	0.59	6.32	0.59
2004	0.00	5.60	0.00	4.99	5.97	0.59
2005	0.00	5.74	0.00	5.13	6.04	0.63
2006	0.00	5.92	0.00	5.30	6.15	0.68
2007	0.00	6.11	0.00	5.49	0.00	6.02
2008	0.00	6.31	0.00	5.70	0.00	6.21
2009	0.00	6.49	0.00	5.90	0.00	6.36
2010	0.00	6.69	0.00	6.14	0.00	6.53
2011	0.00	6.91	0.00	6.39	0.00	6.73
2012	0.00	7.12	0.00	6.64	0.00	6.92
2013	0.00	7.30	0.00	6.84	0.00	7.12
2014	0.00	7.44	0.00	7.02	0.00	7.29
2015	0.00	7.56	0.00	7.16	0.00	7.45
2016	0.00	7.55	0.00	7.15	0.00	7.54
2017	0.00	7.46	0.00	7.03	0.00	7.58
2018	0.00	7.34	0.00	6.84	0.00	7.62
2019	0.00	7.26	0.00	6.69	0.00	7.61
2020	0.00	7.26	0.00	6.63	0.00	7.58

In the revised NES and shipments analysis, operating costs along with the different model parameters and assumptions affect the base case shipments projection. The baseline shipments differ because of the shipment scenario elasticities.

Tables 11.11 through 11.13 illustrate the shipment forecasts. For most efficiency levels there is a drop in shipments beginning at the standard year (2004), with an increasingly negative impact on sales at the more-stringent-standard levels. The medium price/income elasticity scenario is associated with a less negative impact on sales in the year the standard is introduced than the high price elasticity scenario. Figure 11.2 shows the magnitude of the shipment scenarios for the two-tier standard. Notice the two dips, one beginning in 2004, and the other 2007, resulting from the two standard dates. The shipment forecasts of the other standard scenarios behave in the same manner as Figure 11.2.

Table 11.12 Clothes Washer Shipment Forecasts for the Base Case and Standard Case (Medium Price/Income Elasticity Shipment Scenario)

Clothes Washer Shipments			**(Medium Price/Income Elasticity Scenario)**					
	Baseline		***Trial Standard Level 1***		***Trial Standard Level 2***		***Trial Standard Level 4***	
			Eff. Improvement = 20%		***Eff. Improvement = 25%***		***Eff. Improvement = 35%***	
	Base Case	***MEF=.817***	***MEF=1.021***		***MEF=1.089***		***MEF=1.257***	
Year	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***	***V-Axis***	
	Shipment	***Shipment***	***Shipment***	***Shipment***	***Shipment***	***Shipment***	***Shipment***	
	million	*million*	*million*	*million*	*million*	*million*	*million*	
1999	6.36	0.46	6.36	0.46	6.36	0.46	6.36	Year
2000	6.39	0.49	6.39	0.49	6.39	0.49	6.39	0.49
2001	6.40	0.53	6.40	0.53	6.40	0.53	6.40	0.53
2002	6.38	0.56	6.38	0.56	6.38	0.56	6.38	0.56
2003	6.34	0.59	6.34	0.59	6.34	0.59	6.34	0.59
2004	6.32	0.63	6.32	0.63	6.29	0.62	0.00	6.63
2005	6.36	0.67	6.35	0.67	6.33	0.66	0.00	6.73
2006	6.44	0.71	6.43	0.71	6.41	0.71	0.00	6.87
2007	6.53	0.76	6.53	0.76	6.51	0.75	0.00	7.04
2008	6.64	0.81	6.64	0.81	6.62	0.80	0.00	7.21
2009	6.71	0.85	6.71	0.85	6.70	0.85	0.00	7.36
2010	6.81	0.90	6.81	0.90	6.80	0.90	0.00	7.54
2011	6.91	0.96	6.91	0.96	6.90	0.96	0.00	7.72
2012	7.01	1.01	7.01	1.01	7.00	1.01	0.00	7.90
2013	7.08	1.06	7.08	1.06	7.08	1.06	0.00	8.04
2014	7.12	1.11	7.12	1.11	7.12	1.11	0.00	8.15
2015	7.14	1.15	7.14	1.15	7.14	1.15	0.00	8.23
2016	7.14	1.20	7.14	1.20	7.15	1.20	0.00	8.26
2017	7.14	1.24	7.14	1.24	7.14	1.24	0.00	8.26
2018	7.14	1.28	7.14	1.28	7.14	1.28	0.00	8.27
2019	7.18	1.33	7.18	1.33	7.18	1.33	0.00	8.32
2020	7.22	1.38	7.22	1.38	7.22	1.38	0.00	8.40

Table 11.12 Clothes Washer Shipment Forecasts for the Base Case and Standard Case (Medium Price/Income Elasticity Shipment Scenario) (Continued)

Clothes Washer Shipments			**(Medium Price/Income Elasticity Scenario)**			
	Trial Standard Level 5		***Trial Standard Level6***		***Trial Standard Level 3***	
	Eff. Improvement = 40%		***Eff. Improvement = 50%***		***Eff. Improvement =21.4%/35.2%***	
	MEF=1.362		***MEF=1.634***		***MEF=1.09/1.26***	
Year	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***
	Shipment	***Shipment***	***Shipment***	***Shipment***	***Shipment***	***Shipment***
	million	*million*	*million*	*million*	*million*	*million*
1999	6.36	0.46	6.36	0.46	6.36	0.46
2000	6.39	0.49	6.39	0.49	6.39	0.49
2001	6.40	0.53	6.40	0.53	6.40	0.53
2002	6.38	0.56	6.38	0.56	6.38	0.56
2003	6.34	0.59	6.34	0.59	6.34	0.59
2004	0.00	6.62	0.00	6.44	6.19	0.61
2005	0.00	6.72	0.00	6.54	6.23	0.65
2006	0.00	6.86	0.00	6.69	6.32	0.70
2007	0.00	7.03	0.00	6.86	0.00	7.01
2008	0.00	7.21	0.00	7.05	0.00	7.18
2009	0.00	7.35	0.00	7.21	0.00	7.33
2010	0.00	7.53	0.00	7.40	0.00	7.51
2011	0.00	7.71	0.00	7.59	0.00	7.68
2012	0.00	7.89	0.00	7.78	0.00	7.86
2013	0.00	8.03	0.00	7.94	0.00	8.01
2014	0.00	8.15	0.00	8.06	0.00	8.12
2015	0.00	8.23	0.00	8.14	0.00	8.21
2016	0.00	8.26	0.00	8.16	0.00	8.26
2017	0.00	8.25	0.00	8.14	0.00	8.29
2018	0.00	8.27	0.00	8.13	0.00	8.33
2019	0.00	8.32	0.00	8.16	0.00	8.39
2020	0.00	8.40	0.00	8.23	0.00	8.45

Table 11.13 Clothes Washer Shipment Forecasts for the Base and Standard Case (Medium Price Elasticity Shipment Scenario)

Clothes Washer Shipments				(Medium Price Elasticity Shipment Scenario)				
	Baseline		***Trial Standard Level 1***		***Trial Standard Level 2***		***Trial Standard Level 4***	
			Eff. Improvement = 20%		***Eff. Improvement = 25%***		***Eff. Improvement = 35%***	
	Base Case		***MEF=1.021***		***MEF=1.089***		***MEF=1.257***	
Year	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***	***V-Axis***	***H-Axis***	***V-Axis***	
	Shipment	***Shipment***	***Shipment***	***Shipment***	***Shipment***	***Shipment***	***Shipment***	
	million	*million*	*million*	*million*	*million*	*million*	*million*	
1999	6.33	0.46	6.33	0.46	6.33	0.46	6.33	Year
2000	6.35	0.49	6.35	0.49	6.35	0.49	6.35	0.49
2001	6.35	0.53	6.35	0.53	6.35	0.53	6.35	0.53
2002	6.33	0.56	6.33	0.56	6.33	0.56	6.33	0.56
2003	6.30	0.59	6.30	0.59	6.30	0.59	6.30	0.59
2004	6.29	0.62	6.25	0.62	6.11	0.61	0.00	6.27
2005	6.33	0.66	6.29	0.66	6.16	0.65	0.00	6.38
2006	6.41	0.71	6.38	0.70	6.25	0.69	0.00	6.53
2007	6.51	0.75	6.47	0.75	6.36	0.74	0.00	6.69
2008	6.60	0.80	6.57	0.80	6.47	0.79	0.00	6.87
2009	6.67	0.85	6.64	0.84	6.54	0.83	0.00	7.02
2010	6.75	0.90	6.72	0.89	6.64	0.88	0.00	7.19
2011	6.84	0.95	6.82	0.94	6.74	0.93	0.00	7.38
2012	6.92	1.00	6.90	0.99	6.83	0.99	0.00	7.55
2013	6.98	1.05	6.96	1.04	6.90	1.03	0.00	7.69
2014	7.01	1.09	6.99	1.09	6.94	1.08	0.00	7.80
2015	7.02	1.13	7.00	1.13	6.96	1.12	0.00	7.88
2016	7.02	1.18	7.00	1.17	6.95	1.16	0.00	7.88
2017	7.01	1.21	6.99	1.21	6.92	1.20	0.00	7.84
2018	7.02	1.26	6.99	1.25	6.90	1.24	0.00	7.80
2019	7.04	1.30	7.01	1.30	6.92	1.28	0.00	7.81
2020	7.08	1.35	7.05	1.35	6.95	1.33	0.00	7.86

Table 11.13 Clothes Washer Shipment Forecasts for the Base and Standard Case (Medium Price Elasticity Shipment Scenario) (Continued)

Clothes Washer Shipments			(Medium Price Elasticity Shipment Scenario)			
	Trial Standard Level 5		*Trial Standard Level 6*		*Trial Standard Level 3*	
	Eff. Improvement = 40%		*Eff. Improvement = 50%*		*Eff. Improvement = 21.4%/35.2%*	
	MEF=1.257		*MEF=1.634*		*MEF=1.09/1/26*	
Year	*V-Axis*	*H-Axis*	*V-Axis*	*H-Axis*	*V-Axis*	*H-Axis*
	Shipment	*Shipment*	*Shipment*	*Shipment*	*Shipment*	*Shipment*
	million	*million*	*million*	*million*	*million*	*million*
1999	6.33	0.46	6.33	0.46	6.33	0.46
2000	6.35	0.49	6.35	0.49	6.35	0.49
2001	6.35	0.53	6.35	0.53	6.35	0.53
2002	6.33	0.56	6.33	0.56	6.33	0.56
2003	6.30	0.59	6.30	0.59	6.30	0.59
2004	0.00	6.26	0.00	5.93	6.08	0.60
2005	0.00	6.37	0.00	6.05	6.13	0.64
2006	0.00	6.52	0.00	6.20	6.22	0.69
2007	0.00	6.68	0.00	6.38	0.00	6.63
2008	0.00	6.86	0.00	6.56	0.00	6.81
2009	0.00	7.01	0.00	6.72	0.00	6.95
2010	0.00	7.18	0.00	6.92	0.00	7.11
2011	0.00	7.37	0.00	7.12	0.00	7.29
2012	0.00	7.55	0.00	7.32	0.00	7.46
2013	0.00	7.69	0.00	7.48	0.00	7.61
2014	0.00	7.79	0.00	7.60	0.00	7.73
2015	0.00	7.87	0.00	7.69	0.00	7.83
2016	0.00	7.87	0.00	7.68	0.00	7.88
2017	0.00	7.83	0.00	7.60	0.00	7.90
2018	0.00	7.79	0.00	7.52	0.00	7.93
2019	0.00	7.80	0.00	7.48	0.00	7.95
2020	0.00	7.84	0.00	7.50	0.00	7.98

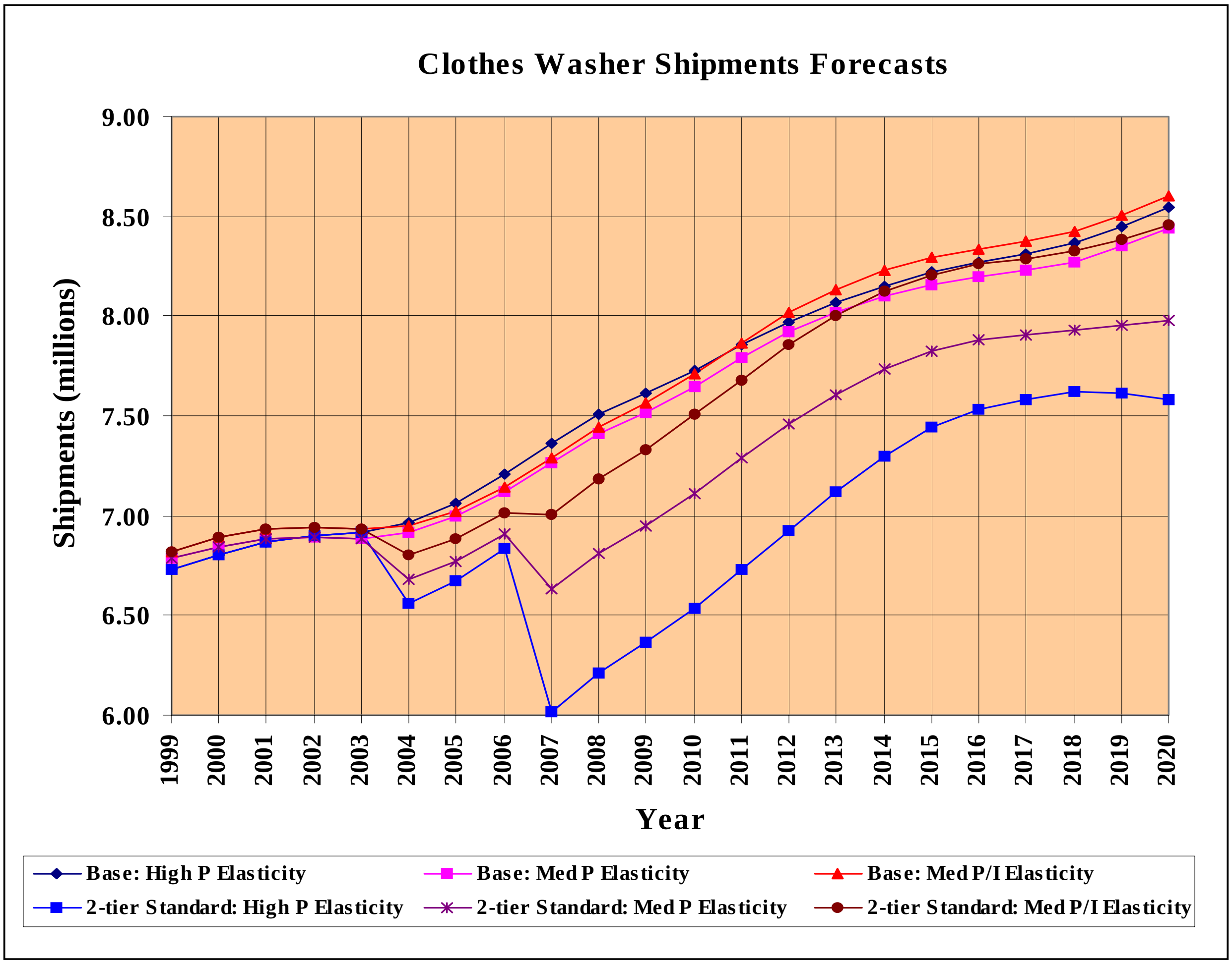

Figure 11.2 Clothes Washer Shipment Forecasts for Base Case and the Negotiated Standard Level

Table 11.14 provides the percent decrease between the base and standard year shipments for 2004, 2009, and 2007 (for the two-tier efficiency standard).

Table 11.14 Percentage Decreases in Shipments

Trial Standard Level	High Price Elasticity Shipment Scenario		Medium Price Elasticity Shipment Scenario		Medium P/I Elasticity Shipment Scenario	
	2004 (% decrease)	2009 (% decrease)	2004 (% decrease)	2009 (% decrease)	2004 (% decrease)	2009 (% decrease)
1	2.0	1.4	0.6	1.4	1.1	0.0
2	8.0	5.7	209	0.9	0.6	0.2
3	5.8/18.3	16.4	3.4/8.6	7.6	2.2/3.9	3.1
4	19.3	14.6	9.3	6.7	4.6	2.7
5	19.6	14.8	9.5	6.8	4.7	2.8
6	28.4	22.5	14.2	10.6	7.4	4.7

Table 11.14 shows the effects of the standards in the standard year and 5 years following the standard year. Following an initial decline in shipments in the year the standard is introduced (2004), shipments gradually start recovering to the baseline shipment forecasts. A standard level 1(MEF=1.021) using the medium P/I elasticity shipment scenario has the least impact on shipments.

During the interviews, manufacturers were asked for their reactions to the high-price elasticity shipment forecast and invited to contrast them to their own expected product shipments with and without new energy-efficiency standards. The vast majority of manufacturers commented that the shipment forecasts appeared reasonable. They were particularly supportive of the "shape" of the curves-a sharp drop in the standard year followed by a partial recovery in later years. They expressed the view that short-term effects were explained by the increased proportion of consumers electing to repair washers instead of replacing them in the event of a breakdown. Eventually, the "extended-life" washers would need to be replaced, and the market would equilibrate at a new, higher, clothes washer average stock age.

The magnitude of the projected drop in shipments was at the higher end of what manufacturers expected. All believed that drops in shipments of the magnitudes the Department predicts would have devastating effects on the industry.

Offering a contrary view, one manufacturer believed that over time shipments of H-axis washers would return to current levels, based on the assumption that the lifetime of H-axis washers is shorter than for V-axis washers, meaning that over time consumers would have no option but to replace their washers.

11.2.3.1 Impact of New Energy-Efficiency Standards for Clothes Washers on Export Sales

Export sales are not included in the shipment forecasts shown in Tables 11.11 through 11.14 and in Figure 11.2. The shipment forecasts developed for the NES include only clothes washers that are being used domestically. The NES spreadsheet calculates the national energy savings; hence, the shipments used in this spreadsheet include clothes washers that are:

- manufactured in the United States for the domestic market
- imported for use in the domestic market

Export and import statistics for the United States (U.S.) clothes washer industry, obtained from the AHAM Fact Book, are presented in Table 11.15. The AHAM Fact Book reports shipments under three categories: (1) industry unit shipments (including shipments for the U.S. market whether imported or domestically produced, and export shipments); (2) exports; and (3) imports. (Export and import data in the AHAM Fact Book is obtained from the Department of Commerce's EM545 and IM145 reports, respectively.)

Table 11.15 Annual Shipments of Clothes Washers from 1990 through 1996 (million)

Shipments	1990	1991	1992	1993	1994	1995	1996
Industry unit shipments	6.192	6.197	6.515	6.793	7.035	6.901	7.129
Export	0.601	0.690	0.756	0.764	0.868	0.801	0.884
Import	0.044	0.035	0.077	0.132	0.100	0.105	0.145

Source: AHAM Fact Book

As can be seen in Table 11.15, export sales accounted for approximately 12.5 percent of industry unit shipments in 1996.

Most manufacturers that were interviewed were adamant that export sales would be significantly hurt by the introduction of new energy-efficiency standards. They would become less competitive internationally if the new standards forced them to completely retool, thereby incurring additional costs which be would be passed on through higher prices.

Manufacturers maintain that, for the purposes of the MIA, retooling costs need to be applied to export volumes as well as to domestic volumes. Since exports represent only a fraction of total sales, manufacturers believe it will not be feasible to continue producing small quantities of older models solely for export as the volumes would not warrant the commitment of dedicated resources. Furthermore, manufacturers believe it is important that the impact of a decline in the export volume of clothes washers also be factored into the industry shipment calculations, as any decline in international competitiveness would reduce industry volumes.

To account for the impact on both domestic and export sales, DOE adjusted the shipment forecasts from the NES spreadsheet for the MIA. The shipment information for 1996 was used for calibration. The calibration process is summarized in Table 11.16.

Table 11.16 Calculation of Calibration Factor for GRIM Shipment Forecast

Shipments(million)	AHAM Fact Book	DOE Shipment Forecast	Calibration Factor (applied to DOE Shipment Forecast)
Industry unit shipments*	7.129		
Export	0.884		
Import	0.145		
Clothes washers used domestically	6.245	6.120	
Clothes washers produced by U.S. manufacturers (domestic + export)	6.984		1.141 (=6.984/6.120)

*Includes 1996 shipments for the U.S. market whether imported or domestically produced, and export shipments
Source: AHAM Fact Book

11.2.4 Manufacturing Costs

11.2.4.1 Baseline Industry Cost Structure

The GRIM developed for the NOPR MIA analysis considers V-axis and H-axis clothes washer segments separately. The baseline cost of an H-axis washer was characterized using the incremental cost data representing a 35 percent efficiency improvement level (standard level 4) as submitted by AHAM, i.e., the Base Case H-axis washer is assumed to be an H-axis machine representing a 35 percent efficiency improvement over the baseline V-axis machine (MEF=0.817). H-axis costs are equal to the Base Case V-axis costs plus incremental costs for a 35 percent efficiency-improvement level.

Definition of H-axis cost assumptions used in the GRIM analysis

H-Axis Material Cost	Baseline V-axis material cost + Incremental material cost for the 35percent efficiency level
H-Axis Labor Cost	Baseline V-axis labor cost + Incremental labor cost for the 35 percent efficiency level
H-Axis Overhead Cost	Baseline V-axis overhead cost + Incremental overhead cost for the 35 percent efficiency level
H-Axis Depreciation Cost	Baseline V-axis depreciation cost + (Incremental capital conversion cost per unit for the 35 percent efficiency level / useful life of the fixed investment)

Publicly available information suggests that currently sold H-axis washers are, on average, more profitable than the baseline V-axis washers characterized in GRIM. To reflect this, the GRIM assumes a profit of 10 percent before tax for the H-axis segment, compared to 6.2 percent for the V-axis market. This profit level likely understates the current profitability of H-axis models but accounts for the expected increased competition in this segment in future years.

The baseline H-axis washer price was estimated using the baseline H-axis washer costs and applying the markup needed to arrive at a 10 percent profit-before-tax value. This corresponds to a markup of 1.5 over the incremental full production cost at the 35 percent efficiency level (standard level 4). Adding this amount to the baseline V-axis price of $285.90 results in a Base Case H-axis washer price of $478.16.

Definition of H-axis price assumption used in GRIM analysis

H-Axis Manufacturer Price	Baseline V-axis manufacturer price + Mark-up x (Incremental full production cost per unit)*
* Incremental full production cost per unit	Incremental material + incremental labor + incremental overhead + capital conversion + design conversion

Table 11.17 summarizes the revised cost structures for baseline V-axis and H-axis washers.

Table 11.17 Industry Average Baseline Cost Structure

Parameters	V-Axis Washers		H-Axis Washers	
	As a % of V-axis baseline	$ per unit	Incr. Cost over V-axis	$ per unit
Manufacturer price	100%	$285.90		$478.16
Manufacturing Cost				
Material	52.0%	$148.70	$86.73	$235.43
Labor	10.2%	$29.30	$10.94	$40.24
Overhead	8.3%	$23.45	$7.78	$31.23
Depreciation	3.5%	$10.01	$22.72	$27.70
SG&A	18.0%	$51.46		$86.07
R&D	1.8%	$5.15		$8.61
Profit before tax	6.2%	$17.73		$48.88
Tax rate	42.8%			
Profit after tax	3.6%	$10.14		$27.96

11.3 IMPACTS ON CASH FLOW

Manufacturers were invited to discuss their interpretations of the cash flow analysis results for the various potential standards levels and comment on the implications of the results for the future of their business.

11.3.1 Base Case NPV

Using the shipment information in Section 11.2.3 and the baseline cost structure described in Section 11.2.4, Base Case cash flow estimates were constructed for the U.S. clothes washer industry. The GRIM spreadsheet models cash flows for the V-axis and H-axis market segments separately in the Base Case. The baseline manufacturer price and cost structure summarized in Table 11.17 was used to develop cash flow estimates and hence the value of the V-axis and H-axis washer segments. The values of these two segments were then summed to arrive at the overall industry value in the Base Case.

The assumptions used to arrive at the Base Case NPV along with the Base Case cash flow spreadsheet outputs are presented in Appendix P, Exhibits 1 through 5, for the medium price shipment elasticity scenario. Based on these assumptions, Base Case clothes washer industry values (NPV) of $1,445.8, $1,439.1, $1,452.0 million were calculated for the high price, medium price, and medium price/income elasticity shipment scenarios respectively.

11.3.2 Standard Case NPV

The Department used the interviews to understand each manufacturers' ability to pass through its incremental costs at the various standards levels. Some manufacturers provided us with their cash flow analysis using the GRIM spreadsheet while others provided information on manufacturing costs, markups, cost pass-through assumptions, prices, and expected shipments, which were then used to develop their standards-induced changes in NPV. These manufacturer estimates or implied changes in NPV were aggregated to arrive at the change in industry NPV at each of the potential standards levels.

The cash flows incorporate each manufacturer's forecasts of the competitive dynamics set in motion by potential new standards at all possible efficiency levels. A partial list of considerations includes:

- The technology status of existing product offerings as it relates to the cost-efficiency relationship
- The status of manufacturing technology, including an assessment of conversion and restructuring costs
- Likely product offerings at each efficiency level (e.g., V-axis, H-axis)
- Consumer demand for product features and its implications for trade-offs between manufacturing cost and consumer utility
- Patent restrictions on design options
- Brand equity
- Availability of technical and financial resources
- Manufacturing versus sourcing strategies
- Company cost structure and ability to pass on fixed (and sometimes even variable) costs

11.3.2.1 Impact of Standards on Manufacturer Prices and Profit Margins

During the interviews, manufacturers were asked to explain differences, if any, between their expected product prices with and without new energy-efficiency standards and those presented in the sample results for the industry as a whole. Manufacturers discussed their assumptions concerning gross and net margins (as a percent of revenue) pre- and post-standards, and causes for any change. Finally, DOE probed as to what mark-ups manufacturers expected to obtain at the various efficiency levels and what effects these new prices might have on their market share.

At higher standards manufacturers stated that, based partially on the shipment forecasts, there will definitely be an impact on profit margins, as the clothes washer business is volume-based. Decreased volumes will erode profit margins for manufacturers due to increased fixed and capital costs. Moreover, manufacturers felt that because the clothes washer industry is volume-based, any drop in volume is likely to result in price decreases as the larger manufacturers try to regain their volumes.

An important point raised in the discussions with some manufacturers is that historically the appliance industry has not been an industry where one can recuperate standard-induced capital costs in prices. Over time, industry margins have actually decreased as large manufacturers, who need certain volumes to operate efficiently, are willing to reduce margins to increase volume. This has considerable significance when evaluating possible scenarios and the impacts on manufacturers, especially for smaller manufacturers who would be particularly disadvantaged.

The profit margin impact would be minimized if manufacturers could produce higher-efficiency products at small incremental costs without lowering product utility. However, as manufacturers believe this is not possible, and they cannot significantly pass on their fixed costs (prevalently because customers are unwilling to pay higher prices for higher-efficiency products), profit margins will likely erode or be destroyed. The industry's costs will increase and, while the price of an average washer will also increase, not all costs will be passed on to consumers. Manufacturers expect that those among them with market power will continue to set prices and the remaining members of the industry will adapt and accept any resulting impacts on profitability if they wish to remain in the market.

11.3.2.2 Impact of New Energy-Efficiency Standards on Manufacturing Costs

The majority of manufacturers maintained that it is not possible to attain a greater than 20 percent improvement (standard level 1) without significantly affecting consumer utility or incurring large cost increases.

Most manufacturers stated that to achieve standard levels 1 and 2 there is no option but to retool their existing V-axis washer platforms. Based on the capabilities of their current platforms, some manufacturers reported their first significant investment thresholds at standard level 1 (20% improvement) while all others reported it at standard level 2 (25% improvement). For most clothes washers that are produced, spin speeds are already at approximately 650-700 rpm and to go higher would require retooling for new platforms as machine stability would be affected. However, manufacturers indicated that improvements of up to 15 percent above baseline (MEF=0.961) maybe achieved by experimenting with design options (e.g., increased spin speeds and cycle time).

The manufacturer responses are consistent with the AHAM cost data, which clearly shows a step jump in investment levels beyond the 15 percent efficiency level (MEF= 0.961) -at the 15 percent level the total industry conversion costs are $36.08 million, compared to conversion costs of $221.9 million and $689.2 million at the 20 percent (MEF=1.021) and 25 percent (MEF=1.089) efficiency levels, respectively. Manufacturers estimate that these retooling costs would be in the vicinity of $100-$120 per annual unit of production. We in fact found a significant relationship between capital investment and production volume, which is detailed in Section 11.6 of this report.

Some manufacturers stated that going above 15 percent (to 20 percent) without retooling could be achieved through various temperature- and water-control measures (such as rinse cycle, spin speed, or spin time), although even these would require incurring significant incremental cost and could affect consumer utility to differing degrees. Adaptive fill or control measures would also not be viable as they would have too great an impact on consumer prices. As shown by the focus group results in the consumer studies, some of the top consumer concerns are price, load-size options, durability, water-temperature options, wash-cycle options, etc., all of which may be affected by changes in the standards. The only top-10 rated attributes that will clearly be improved by the new standards are energy and water costs.

Manufacturers believe the rise in aggregate industry costs is significant and will lead to lower customer demand for clothes washers. But perhaps even more important to their own bottom line are the differential costs among manufacturers of achieving high efficiency levels, as well as relative expertise in the new technology. As such, the cash flows include each manufacturer's understanding of its own position vis-à-vis other manufacturers on these issues.

Most manufacturers stated that at standard level 4 they would have to build H-axis washers to comply with the regulations. Thus, the few manufacturers that do have an expertise in H-axis technology are likely to be competitive at the higher standard levels. At the same time, some manufacturers felt it was possible that one or more of their competitors could produce a high-efficiency V-axis washer that met standard level 4 (35 percent improvement). Such a scenario could significantly alter the industry's competitive dynamics due to the possible price and consumer utility advantages of a V-axis machine over an H-axis washer.

Some firms were concerned that patent restrictions could prevent them from achieving standard level 2 (25 percent improvement in efficiency) using V-axis designs. Consequently, they believe this level of improvement can only be achieved by moving to H-axis technology. For them, the capital investment required for a 25 percent improvement would thus be no different from that required for a 35 percent improvement(standard level 4).

Manufacturers were asked if they could provide some insight into the variations of costs at each efficiency level. Some manufacturers indicated that, for new standards within V-axis technology, the range in costs observed in the industry submittal may reflect different technology jump points. For instance, existing suspension systems may allow some manufacturers to increase spin speed. For others, increases in efficiency may be achieved with adjustments in other components.

U.S. manufacturers have been producing V-axis washers for almost 40 years and have reduced their costs and optimized their designs to an extent that there isn't much variation among different manufacturers. In contrast, H-axis washers are relatively new in the U.S.. Few of the manufacturers have sufficient manufacturing expertise in that technology; thus the range of costs is greater for H-axis clothes washers. Even manufacturers that have European divisions that produce H-axis machines find that these machines have small capacities that do not scale-up easily for the U.S. market.

Finally, some manufacturers stated that warranty costs would probably increase at higher standard levels. Warranty costs typically run at 2 to 3 percent of revenues. Past experience indicates that warranty, consumer education, and maintenance costs increase significantly in the first few years after a new product is launched. It should be noted that not every manufacturer considered these additional costs in their respective data submittals to AHAM.

11.3.2.3 Definition of Business Scenarios

To capture the uncertainty in future industry dynamics, DOE evaluated the industry financial impacts using two different business scenarios. In the first scenario, the "no consolidation scenario," it is assumed that all current manufacturers continue to manufacture clothes washers and maintain their market share, even if they believe they will be unable to recuperate their incremental costs. This could result in a negative Standard Case NPV for some manufacturers. In the second scenario, the "industry consolidation scenario," it is assumed that some manufacturers would indeed exit the industry or lose significant market share. In this scenario, their volumes are redistributed among the remaining and more profitable players in the industry.

The aggregated industry Standard Case NPV for the two business scenarios is presented in Tables 11.18 through 11.23 for each of the shipment scenarios. Not all manufacturers provided information for standard level 6 (50 percent efficiency) and hence it was difficult to estimate the total industry impact at these levels. Data for the 50 percent efficiency level was extrapolated from the given data.

We also present results for a two-tier standard (Trial Standard Level 3), which consists of two standards coming into effect in two distinct years. The two-tier standard modeled in this chapter has an initial level of 21.4% efficiency improvement (MEF=1.04) effective in 2004 and a second level representing a 35.2% efficiency improvement (MEF=1.26) effective in 2007. Tier one (1.04 MEF in 2004) is modeled as a simple one-tier standard with effective date 2004. Tier two (1.26 MEF in 2007) is modeled as a one-tier standard delayed by three years. The GRIM model combines the cash flows. The operating principles for the two-tier standard are presented in Appendix P.

11.3.2.4 "No Consolidation" Scenario

The cash flow results for the three shipment scenarios are presented in Tables 8 through 10 for the "no consolidation" business scenario. Results are presented for Trial Standard Levels 1 through 6.

Table 11.18 Industry Cash Flow Results for the "No Consolidation" Scenario - High Price Elasticity

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	1,445.8	1,417.6-1,346.7	(28.1)-(99.1)	(1.9)-(6.9)
2	1.089	1,445.8	1,005.2-852.9	(440.5)-(592.9)	(30.5)-(41.0)
3	1.04 in 2004 1.26 in 2007	1,445.8	948.6-846.7	(497.2)-(599.0)	(34.4)-(41.4)
4	1.257	1,445.8	877.1-781.9	(568.7)-(663.9)	(39.3)-(45.9)
5	1.362	1,445.8	930.1-863.1	(515.7)-(582.7)	(35.7)-(40.3)
6	1.634	1,445.8	876.8-722.2	(569.0)-(723.5)	(39.4)-(50.0)

Table 11.19 Industry Cash Flow Results for the "No Consolidation" Scenario – Medium Price Elasticity

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	1,439.1	1,420.4-1,349.5	(18.7)-(89.6)	(1.3)-(6.2)
2	1.089	1,439.1	1,033.8-877.2	(405.2)-(561.9)	(28.2)-(39.0)
3	1.04 in 2004 1.26 in 2007	1,439.1	1,027.8-920.8	(411.0)-(518.3)	(28.6)-(36.0)
4	1.257	1,439.1	944.7-842.3	(494.4)-(596.8)	(34.4)-(41.5)
5	1.362	1,439.1	1,002.1-929.9	(437.0)-(509.2)	(30.4)-(35.4)
6	1.634	1,439.1	989.7-815.2	(449.4)-(623.8)	(31.2)-(43.3)

Table 11.20 Industry Cash Flow Results for the "No Consolidation" Scenario - Medium Price/Income Elasticity

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	1,452.0	1,438.8-995.8	(13.2)-(85.3)	(0.9)-(5.9)
2	1.089	1,452.0	1,061.2-899.6	(390.8)-(552.4)	(26.9)-(38.0)
3	1.04 in 2004 1.26 in 2007	1,452.0	1075.2-962.9	(376.8)-(489.1)	(25.9)-(33.7)
4	1.257	1,452.0	995.8-887.5	(456.2)-(564.5)	(31.4)-(38.9)
5	1.362	1,452.0	1,056.6-980.2	(395.4)-(471.8)	(27.2)-(32.5)
6	1.634	1,452.0	1,029.7-876.8	(422.3)-(575.2)	(29.1)-(39.6)

The cash flow results show a lower industry negative impact at Trial Standard Level 5 than at Trial Standard Level 4. Most manufacturers stated that efficiency improvements at Trial Standard Level 5 could only be met with an H-axis product offering and some reported they would have a competitive advantage if that were the case. In support of this view, individual manufacturer cash flow impacts at Trial Standard Level 5 (expressed as a percentage loss in company value) were far more polarized than at Trial Standard Level 4. Calculating the standard deviation (SD) of company value change at each efficiency level yields the following values: at Trial Standard Level 1 (20% efficiency improvement) the SD in company value change is 11.5%; at Trial Standard Level 2 (25% efficiency improvement) the SD is 11.37%; at Trial Standard Level 4 (35% efficiency improvement) the SD is 17.65%; and at Trial Standard Level 5 (40% efficiency improvement) the SD leaps to 27.65%. This is significant because the greater the difference in impacts between manufactures, the greater the risk of industry consolidation. For Trial Standard Level 3 the SD in individual company percent changes in value is estimated to be 15.76%.[a]

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[a]The Standard Deviation (SD) was calculated using the equation

$$SD = \sqrt{\frac{N}{N-1} \sum_{i}^{N} \left(x_i - \bar{x}\right) MS_i}$$

where

N = Number of manufacturers

i = Manufacturer *i*

x_i = the % change in value of manufacturer *i*

$\bar{x}$ = % change in industry value

MS_i = Market share of manufacturer *i*

To calculate the change in industry value for the consensus proposal it was necessary to interpolate manufacturing costs and prices. Costs and prices for an MEF of 1.04 were derived from data at 20% and 25% efficiency improvement (Trial Standard Levels 1 and 2, respectively). Similarly data for an MEF of 1.26 were interpolated from data at 20% and 25% efficiency improvement. Modeling the cash flows of a two-tier implementation required additional assumptions which are discussed in Appendix P.

Standard Case cash flow spreadsheet outputs for Trial Standard Level 4 (35 percent efficiency) are presented in Appendix P, Exhibits 9 through 14, and for Trial Standard Level 3 (two-tier standard) in Exhibits 19 through 24. For the V-axis standard levels (5 percent through 25 percent) the GRIM spreadsheet assumes that the H-axis market segment in the Standards Case will remain a market niche, as in the Base Case, and hence the industry will maintain its value on H-axis washers. For H-axis standard levels (35 percent and higher), only H-axis washers will be sold in the market post-standards and a single markup assumption is used.

11.3.2.5 Consolidation Scenario

At Trial Standard Level 2, some manufacturers predicted that one or more of the current manufacturers would most likely exit the industry as the investments required to reach such standards would be of a sufficient scale to drive them out of business. Other manufacturers indicated that based on their perceived inability to pass on fixed (and sometimes even variable) costs it may be more profitable for them to cease manufacturing washers; they might, however, source and distribute them, as they believe they need to continue offering a full product line to compete effectively in the appliance industry. These effects would result in industry consolidation whereby the manufacturers that remain in the business experience an increase in their volumes and a corresponding increase in their Standard Case NPVs. This is reflected in the cash flow results for Trial Standard Levels 1 through 6 in Tables 11.21 through 11.23.

Table 11.21 Industry Cash Flow Results for the " Industry Consolidation" Scenario - High Price Elasticity

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	1,445.8	1,417.6-1,346.7	(28.1)-(99.1)	(1.9)-(6.9)
2	1.089	1,445.8	1,004.6-872.1	(441.2)-(573.7)	(30.5)-(39.7)
3	1.04 in 2004 1.26 in 2007	1,445.8	1,215.9-1,068.4	(229.9)-(377.4)	(15.9)-(26.1)
4	1.257	1,445.8	1,187.1-1,038.3	(258.7)-(407.5)	(17.9)-(28.2)
5	1.362	1,445.8	1,239.4-1,124.5	(206.4)-(321.3)	(14.3)-(22.2)
6	1.634	1,445.8	1,186.6-1,009.3	(259.1)-(436.5)	(17.9)-(30.2)

Table 11.22 Industry Cash Flow Results for the "Industry Consolidation" Scenario - Medium Price Elasticity

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	1,439.1	1,420.4-1,349.5	(18.7)-(89.6)	(1.3)-(6.2)
2	1.089	1,439.1	1,033.2-896.9	(405.9)-(542.1)	(28.2)-(37.7)
3	1.04 in 2004 1.26 in 2007	1,439.1	1,312.1-1,156.3	(127.0)-(282.7)	(8.8)-(19.6)
4	1.257	1,439.1	1,278.2-1,118.1	(160.9)-(321.0)	(11.2)-(22.3)
5	1.362	1,439.1	1,335.2-1,211.5	(103.8)-(227.6)	(7.2)-(15.8)
6	1.634	1,439.1	1,339.3-1,139.2	(99.8)-(299.9)	(6.9)-(20.8)

Table 11.23 Industry Cash Flow Results for the "Industry Consolidation" Scenario - Medium Price/Income Elasticity

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	1,452.0	1,438.8-1,366.7	(13.2)-(85.3)	(0.9)-(5.9)
2	1.089	1,452.0	1,060.5-920.0	(391.5)-(532.0)	(27.0)-(36.6)
3	1.04 in 2004 1.26 in 2007	1,452.0	1,375.0-1,211.4	(77.0)-(240.6)	(5.3)-(16.6)
4	1.257	1,452.0	1,348.5-1,179.2	(103.5)-(272.8)	(7.1)-(18.8)
5	1.362	1,452.0	1,409.2-1,278.3	(42.8)-(173.7)	(2.9)-(12.0)
6	1.634	1,452.0	1,443.4-1,227.0	(8.6)-(225.0)	(0.6)-(15.5)

The values in Tables 11.21 through 11.23 represent results based on the Department's estimates of possible shifts in market share based on manufacturer interviews and observed differences in costs and profitability. As can be observed by comparing Tables 11.18 through 11.20 and Tables 11.21 through 11.23, consolidation is assumed to begin at Trial Standard Level 2 (25 percent improvement) and become very significant at Trial Standard Level 4 (35 percent improvement).

The outcome of industry consolidation is a redistribution of volumes from less-profitable manufacturers to more-profitable manufacturers and therefore a lower total reduction in industry value (relative to the no-consolidation scenario). Furthermore, the cash flow may overstate the negative impact as it does not consider the increased market power of an industry with fewer competitors (possibly three or four instead of six) or more concentration of market share.

11.4 IMPACT ON CLOTHES DRYER BUSINESS

An important consideration regarding new efficiency standards that came to light during the course of DOE's interviews with manufacturers was the pull-through effect of clothes washers on the clothes dryer market. The majority of manufacturers indicated that stringent standards on clothes washers would have an effect on dryers as consumers frequently buy washers and dryers as a set. From the manufacturers' data, it is estimated that approximately 45 percent to 55 percent of washers are sold in pairs with dryers. Therefore, any change in washer volumes will impact a significant portion of the dryer business. A separate cash flow analysis was run in an effort to model the financial impact of these considerations on the dryer business.

In conducting the cash flow analysis, the GRIM assumes that 50 percent of clothes washers are sold as pairs with dryers and that the purchase of these paired dryers will be directly impacted by any changes in washer volumes. The GRIM estimates the NPV of the clothes dryer business both in the absence and the presence of a standard. If a new standard results in a decrease in clothes washer sales, this negatively impacts the sales of dryers, thereby reducing the NPV of the dryer business. Shipment forecasts for the Dryer cash flows correspond to the same NES shipments used to run the Clothes Washer cash flows.

The Department used industry-average values of manufacturer prices, shipments, manufacturing costs and financial information to perform the dryer cash flow analysis. Industry-average manufacturer prices were obtained from the CIR. The shipment-weighted price is obtained by dividing the dollar value of all dryers (both gas and electric) shipped from factories by the quantity of shipments. Clothes dryer shipments, including those exported and imported, were obtained from the AHAM Fact Book. Table 11.24 provides the shipment-weighted manufacturer price and shipments of clothes dryers from 1990 through 1996.

Table 11.24 Shipment-weighted Manufacturer Price of Dryers from 1990 through 1996

Year	1990	1991	1992	1993	1994	1995	1996
Manufacturer Price ($)	211.5	213.8	214.5	217.0	233.7	223.4	224.8
Clothes Dryer Shipments (000)							
Industry unit shipments*	4320	4313	4717	5074	5339	5225	5528
Export	105.9	169.2	201.6	181.6	217.4	207.5	368.8
Import	57.4	76.1	140.4	190.1	191.4	324.9	446.4
Dryers produced by U.S. manufacturers	4262.6	4236.9	4576.6	4883.9	5147.6	4900.1	5081.7

* Includes shipments for the U.S. market whether imported or domestically produced, and export shipments.

The GRIM considers the impact of clothes dryers produced by U.S. manufacturers. The 1996 dryer shipments of 5.08 million are used to develop the Base Case shipment forecasts. Future Base

Case dryer sales are forecasted using the growth rate projections from the Base Case clothes washer shipment forecasts. Standard Case dryer shipments are calculated assuming that 50 percent of clothes washers are sold as pairs with dryers. Hence, for each standard level analyzed, a drop in clothes washer shipments results in a drop in the dryers that are bought as pairs. Any drop in dryer sales resulting from a standard will result in a negative financial impact on the dryer business.

Disaggregated manufacturing costs, namely material, labor and overhead, and financial information including tax rate, working capital, depreciation, cost of capital, etc., were obtained from a top-down analysis of the appliance industry. These inputs are similar to those used for the clothes washer cash flow analysis. Table 11.25 presents the cost and financial information used in the Dryer cash flow analysis; assumptions for the GRIM Dryer analysis are presented in Appendix P, Exhibit 6.

Table 11.25 Cost and Financial Information Used in the GRIM Dryer Analysis

Input Parameters	**Percent of revenue**	**Dollar per Unit**
Manufacturer price	100%	$220.4
Manufacturing Cost		
Material	52%	$114.6
Labor	10.2%	$22.5
Overhead (excluding depreciation)	8.2%	$18.3
Depreciation	3.5%	$7.7
Financial Information		
Tax rate	42.8%	
Discount rate for NPV	6.65%	
Working Capital	10.5%	
Standard SG&A	18.0%	
R&D	1.8%	
Ordinary Capital Expenditure	3.9%	
Net Profit before tax	6.2%	

Using the above inputs, the GRIM spreadsheet was used to analyze the financial impacts at each standard level and shipment scenario. The Base Case NPV for the clothes dryer business is

$665.2, $665.1, $677.2 million dollars respectively for the high price, medium price and medium price/income elasticity scenarios. Tables 11.26 through 11.28 present the Standard Case NPV for Trial Standard Levels 1-6, along with the change in NPV. Base Case cash flows for the medium-price elasticity scenario are presented in Appendix P; Base Case cash flows are in Exhibit 7; cash flows for the 35% level (Trial Standard Level 4) in Exhibit 15 and 16; and cash flows for the two-tier standard (Trial Standard Level 3) in Exhibits 25 and 26.

Table 11.26 Standard Case NPV for Dryer Business - High Price Elasticity Scenario Efficiency Improvement

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	665.2	662.0	(3.12)	(0.5)
2	1.089	665.2	650.8	(14.4)	(2.2)
3	1.04 in 2004 1.26 in 2007	665.2	641.3	(23.9)	(3.5)
4	1.257	665.2	628.5	(36.6)	(5.5)
5	1.362	665.2	627.9	(37.3)	(5.6)
6	1.634	665.2	609.6	(55.6)	(8.4)

Table 11.27 Standard Case NPV for Dryer Business - Medium Price Elasticity Scenario Efficiency Improvement

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	665.1	664.5	(0.6)	(0.1)
2	1.089	665.1	660.6	(4.48)	(0.7)
3	1.04 in 2004 1.26 in 2007	665.1	654.1	(11.0)	(1.7)
4	1.257	665.1	648.3	(16.84)	(2.5)
5	1.362	665.1	647.9	(17.2)	(3.9)
6	1.634	665.1	638.3	(26.8)	(4.0)

Table 11.28 Standard Case NPV for Dryer Business - Medium Price/Income Elasticity Scenario

Trial Standard Level	MEF	Base Case NPV ($million)	Standard Case NPV ($million)	Change in NPV ($million)	% Change in NPV
1	1.021	677.2	677.80	.5	0.1
2	1.089	677.2	677.3	0.1	0.0
3	1.04 in 2004 1.26 in 2007	677.2	673.4	(3.8)	(0.3)
4	1.257	677.2	670.9	(6.3)	(0.9)
5	1.362	677.2	670.8	(6.4)	(1.0)
6	1.634	677.2	665.5	(11.3)	(1.7)

A further concern voiced by manufacturers, besides the impact on dryer sales, is that the clothes dryer may no longer match the clothes washer if the new standard results in significant redesign and retooling of their washer platform. This would decrease the utility of the dryer to the consumer, further impacting sales and leaving manufacturers with stranded inventory. Since washers and dryers are generally designed and sold as matched pairs, it is imperative that they conform to a similar appearance (height, cabinets, control panel, etc.).

At the more stringent standard levels manufacturers expect to significantly redesign and retool their clothes washer platforms, implying a change to the dryer platform as well. Manufacturers estimate that at the more stringent Trial Standard Level of 2 and above, total industry conversion costs for dryers could be in the range of $25 million to $75 million. The GRIM Dryer Analysis does not consider any conversion costs (capital and design) that might be required to upgrade the dryer platforms at the higher standard levels. Any such investments that are not reflected in manufacturer prices would increase the negative impact of standards on the dryer industry's NPV, over and above those presented in the preceding tables.

11.4.1 Dryer Employment Impacts

The close correlation between dryer and clothes washer shipments could also have an impact on employment levels within the dryer business. Manufacturers indicated that approximately 50 percent of clothes washers are sold in pairs with dryers. Any decline in clothes washer shipments would therefore impact dryer shipments. Unlike clothes washers, however, this impact would not be counter-balanced by increased labor requirements due to more labor-intensive machining and assembly requirements. Changes to dryers would primarily entail "cosmetic" adjustments to create a new look to "match" the new washers, rather than a platform change. Consequently, given the assumption that employment basically tracks shipments (or production levels), the expected impact of new clothes washer standards on dryer related employment would be a decline in employment proportionate to the decline in washer-related dryer sales (i.e., the "paired” sales).

The implied impact on dryer related employment is detailed in Figure 11.3 below. As expected, up to a 20 percent improvement in clothes washer efficiency standards (Trial Standard Level 1) has a minimal effect on dryer employment, given that there is a minimal effect on shipments at these levels. The greatest impact is at and above a 35 percent improvement (Trial Standard Level 4 and above), when shipments are expected to decline substantially, resulting in a similar impact on dryer employment levels. At these higher efficiency levels, a 15 to 20 percent decline in washer-related dryer employment, relative to the Base Case, is to be expected; this decline equates to between 300 and 500 jobs in the dryer business.

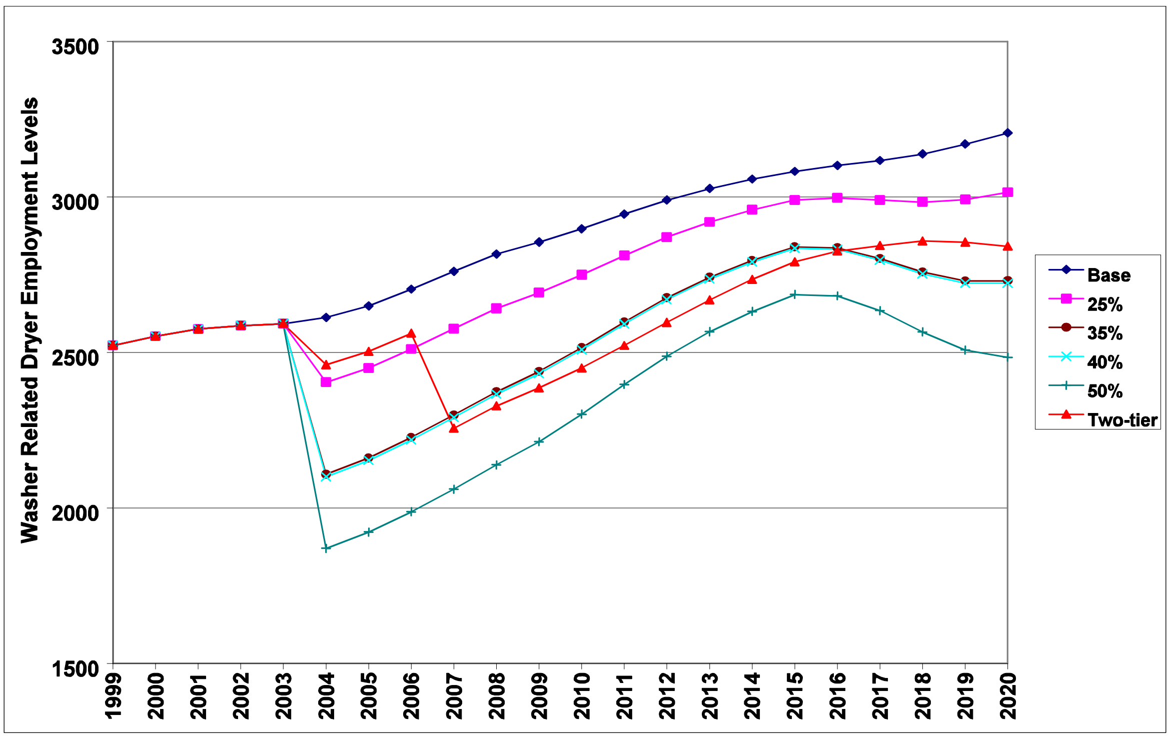

Figure 11.3 Implied Impact of Decline in Washer Shipments on Clothes Dryer Employment Levels

11.5 CLOTHES WASHER REPAIR INDUSTRY ANALYSIS

From the manufacturer interviews and the clothes washer shipments analysis, it became apparent that, should an increase in energy efficiency standards result in higher prices for new clothes washers, consumers may repair old units rather than purchase new ones at the higher price. This section contains an analysis estimating the impact of any change in clothes washer repair revenues on clothes washer manufacturers' NPV.

11.5.1 Key Assumptions

In conducting this analysis, several assumptions were considered:

- The number of repairs performed absent standards and at various Trial Standard Levels
- The average cost of repairs
- The parts/labor split for average repair jobs
- OEM market share for repair parts
- OEM market share for repair labor

Number of Repairs. The number of repairs performed absent standard levels and at various standard levels was estimated using the clothes washer NES-shipment model.

Average Cost of Clothes Washer Repairs. RepairNet.com provides publicly available information on the average cost of clothes washer repairs. Based on surveys of appliance parts distributors and service repair technicians, RepairNet.com provides estimates of the average cost of common repair jobs for each washer manufacturer. A simple average of the costs of all repair jobs for each of the five major manufacturers results in an estimated average repair cost of $133.01. No data is available on how frequently each repair occurred.

In addition, Consumers' Union was contacted for information to provide a cost comparison with the above average repair estimate. According to Consumer Union's Survey Research, data on repair costs have approximately a normal distribution with a trimmed mean of $100 and a range of $60-$130. Given that this mean incorporates the frequency of individual repairs, the $100 figure seems to be the most reasonable estimate.

Parts/Labor Split. As no data was publicly available on this topic, experienced industry personnel were interviewed to derive estimates. These interviews indicated that a representative split for companies who service clothes washers is 80 percent labor and 20 percent parts. This split was confirmed by a combination of independent and manufacturer-affiliated service companies.

To provide some validation on the annual spare parts revenue, we compared our estimates to Census data. In 1996, the Census Bureau reported the value of shipments of parts and accessories for household washing machines at $171 million. Using a cost of $100 per repair and a parts split of 20 percent, the model produces an estimate of $202 million in annual revenue.

OEM Market Share for Repair Parts. In the late 1980's, the National Appliance Parts Suppliers Association (NAPSA) produced a report titled "Future Study of the Appliance Parts Industry." NAPSA interviewed a number of manufacturers and suppliers to gain previously unrecorded knowledge concerning the repair parts industry. Based on responses from the study participants, original equipment manufacturers controlled 68 percent of the appliance parts market. It is well known that many OEM's purchase appliance parts, and repackage them under their own brand. The study did not clarify whether the market share included only OEM-manufactured parts, or OEM-repackaged parts as well. As this distinction could make a difference in the repair revenue returned to the OEM, a range of repair revenues was considered in the analysis.

OEM Market Share for Repair Labor. DOE's research indicates that independent service companies perform approximately 90 percent of post-warranty major appliance repairs, and that this number is most likely to increase in the immediate future. Based on this information, 10 percent of the labor revenue was apportioned to the OEM's.

11.5.2 Impact of New Energy Efficiency Standards on the Repair Industry

Figure 11.4 demonstrates the effect of changes in the efficiency standards on the number of clothes washer repairs performed. The cyclical pattern in the number of repairs is a function of the average unit life and average life extension achieved through repairs.

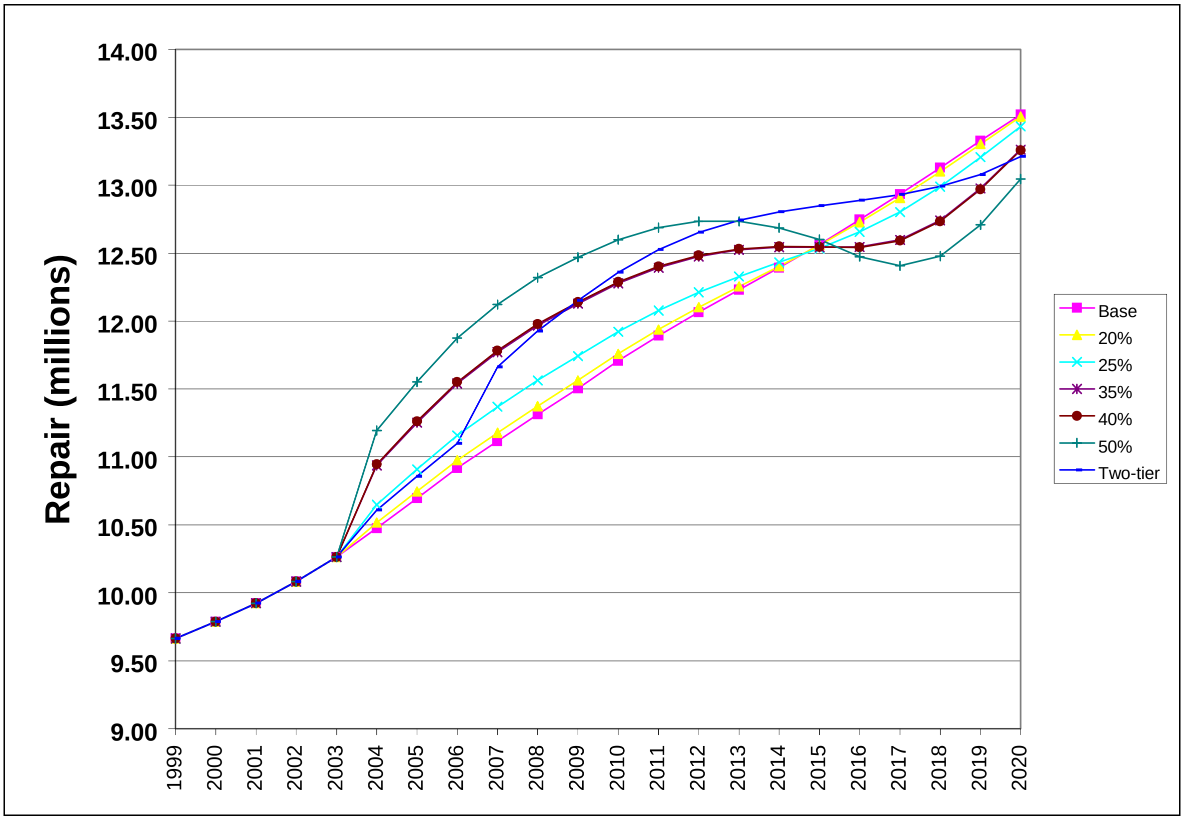

Figure 11.4 Estimated Number of Clothes Washer Repairs (High Price Elasticity Shipment Scenario)

Source: NES-Shipment Spreadsheet

Using the assumptions summarized in Table 11.29, revenue is calculated by multiplying $21.60 (Average OEM revenue per repair) times the number of repairs in a given year. A GRIM Repair Analysis was developed based on the revenues generated from the repairs shown in Figure 11.4. The real impact of these revenues is determined by the extent to which the OEMs are able to profit from them. A typical net profit figure for the electrical repair industry over the last few years is 5 percent.[a] Using this net profit value, the NPV of the estimated profit stream for each shipment scenario is presented in Table 11.30.

[a]Dunn and Bradstreet, Inc., Electrical Repair Industry Profile, October 1999. Gross margin 44%.

Table 11.29 Repair Industry Revenue Assumptions

Average cost of repairs	$100
The parts/labor split for average repair jobs	20%/80%
OEM market share for repair parts	68%
OEM market share for repair labor	10%
Average OEM revenue per repair	**$21.60**

Table 11.30 Net Present Value of OEM Repair Revenues ($ Millions)

Trial Standard Level	MEF	High Price Elasticity	Medium Price Elasticity	Medium Price/Income Elasticity
1	1.021	0.2	0.1	(0.0)
2	1.089	0.7	0.2	(0.1)
3	1.04 in 2004 1.26 in 2007	1.43	0.9	(0.0)
4	1.257	1.7	1.1	0.0
5	1.362	1.8	1.1	0.1
6	1.634	2.4	1.7	0.3

Cash flows for the medium-price elasticity scenario are presented in Appendix P; Base Case cash flows are in Exhibit 8; cash flows for the 35% level (Trial Standard Level 4) in Exhibit 17 and 18; and cash flows for the two-tier standard (Trial Standard Level 3) in Exhibits 27 and 28.

11.6 IMPACTS ON MANUFACTURING CAPACITY

One of the significant outcomes of new standards could be the consequential obsolescence of existing manufacturing assets, including tooling and investment. The Manufacturer Interview Guide used a series of questions to identify impacts on manufacturing capacity. These questions were developed to understand the impact of a clothes washer standard on:

- U.S. and North American manufacturing capacity associated with the production of clothes washers
- Capacity utilization and plant location decisions in the U.S. and North America both with and without standards
- The ability of manufacturers to upgrade or remodel existing facilities to accommodate a new product mix
- The nature and value of stranded assets, if any

During the interviews manufacturers were asked to provide their estimates for any one-time restructuring and other charges, where applicable. These one-time costs were considered in developing the cash flow results for both the "no consolidation" and "industry consolidation" scenarios.

11.6.1 Manufacturing Facilities

The majority of the facilities associated with the manufacture of clothes washers or clothes washer components distributed within the U.S. residential laundry market are located in the U.S., although some manufacturers also have facilities in Canada and Mexico that produce largely for the U.S. market and that would be significantly affected by any change in U.S. standards. The majority of these facilities produce a combination of washers and dryers; however the bulk of volume is driven by washers and any impact on this product affects the capacity utilization of the plant as a whole.

11.6.2 The Impact of New Energy Efficiency Standards on the Production Facility Mix

The impact of any new efficiency standards on the production facility mix depends on the standards chosen. Table 11.31 below illustrates the effect that various standards levels could have on the number of clothes washer and clothes washer component manufacturing facilities; the results indicate at each level either partial or full closure of residential clothes washer or clothes washer component operations at the affected facilities.

The general conclusion from the Department's interviews is that a standard level of 4 or greater (improvement of 35 percent and above) will result in the full or partial closure of the residential clothes washer manufacturing operations at between four to six clothes washer or clothes washer component manufacturing facilities. At Trial Standard Level 4 and above, the vast majority of manufacturers maintain that the level of improvement demanded could only be achieved by converting their platform technology to H-axis from the current V-axis. This would require large-scale investments and broad-based "retooling" of current facilities. At these levels, manufacturers expect at least one further plant would close and it is possible that another participant would exit the industry.

Table 11.31 Manufacturer Implied Impact of New Efficiency Standards on Production Facility Mix

MEF	0.817 (baseline)	0.961	1.021	1.089	1.257
# of Manufacturing Facilities for Clothes Washer*	9	9	9	6-7	5-6
# of Manufacturing Facilities for Clothes Washer components/sub-assemblies*	3	3	2-3	1-2	0-1

*Includes facilities in both the U.S. and Mexico
Source: DOE Interviews of U.S. Clothes Washer Manufacturers

As illustrated, most manufacturers predict that there will be minimal, if any, impact on the number of production facilities up to an MEF of 0.961 (15 percent improvement above the Base Case).

In the range of MEF 1.021 to MEF 1.089 (20 to 25 percent), manufacturers predicted that at least one U.S.-based component manufacturing facility would most likely be partially or fully closed. At least two factors would drive this possible closure:

(i) The overall investment required by manufacturers at this level would be such that in order to pass on increased fixed costs, prices would rise, reducing volumes and creating excess capacity to the extent that some consolidation of production facilities may be warranted.
(ii) Higher manufacturing costs associated with the more stringent efficiency standards are likely to lead to a consolidation in the range of products being manufactured, meaning that some products or product classes could become obsolete. Plants that currently manufacture these products would be closed rather than "retooled" as they would be too small to warrant the investment required to conduct a major retooling of machinery to meet the increased efficiency standards.

One manufacturer indicated its concern that changes above Trial Standard Level 1 (20 percent) would drastically affect its entire product line. Each model would be affected, meaning all products would need to be redesigned and facilities retooled.

The principal factor forcing players to exit the industry at standard levels greater than Trial Standard Level 4 is the amount of investment required to change clothes washer platform technology. Manufacturers estimate that the introduction of a new product or a platform change would cost tens of millions of dollars in product development costs alone. Tooling and equipment investments for a mid-size manufacturer could total well in excess of $100 million. In order to avoid the financial risk associated with these investments, one or more manufacturer may move towards sourcing complete washing machines from other manufacturers or source assembled sub-assemblies.

The time needed to retool production facilities for a new design platform and transition planning is an important consideration. Several manufacturers indicated that it could take more than 3 years of intensive effort to ramp up design to the stage where they could produce a cost-competitive, mass-market, H-axis washer.

11.6.3 The Impact of New Energy Efficiency Standards on Capacity Utilization and Manufacturing Assets Levels at Domestic Production Facilities

The total cost to the industry of stranded assets resulting from new efficiency standards is difficult to judge. The value of stranded assets depends not only on the standard level introduced but also on the year of introduction, the age of existing assets and the method used for depreciation. The value of stranded assets is also driven by the amount of specialized fabrication lines that can be salvaged. In any case, stranded assets would be significantly reduced if there was no requirement to move to a new technology platform, or if the standard introduction date was such that most existing assets were fully depreciated by that time.

The determination of industry and company value discussed in Section 11.3 implicitly takes into account stranded assets. Cash flow analyses are based on a forward-looking assessment of return on future investment. Any decline in value below the Base Case company/industry value implies a loss due to "stranded assets." Specifically, on a cash basis, the cash flow analysis captures stranded assets in the magnitude of the new capital requirements - larger stranded assets lead to greater capital conversion requirements.

DOE examined industry statistics on the value of property, plant and equipment to gain insights into the significance of stranded assets. In Section 11.7 the estimate of stranded assets is used to evaluate the Industry benefit from a greater standards phase-in delay. The analysis also gives context to the industry's data submittal for capital conversion costs. Table 11.32 is an example of the break down of the clothes washer industry's property, plant, and equipment assets as percentage value of industry revenues based on financial information for the appliance industry.

Table 11.32 Clothes Washer Industry Property, Plant and Equipment Forecasts for the Baseline and Trial Standard Level 4 (35 percent Efficiency Improvement)

Industry Statistics	% of Revenue Distribution	Base Case Values Yr 2003 ($ millions)	Standard Case Values Yr 2004 ($ millions)
Revenue	100%	2,374	2,833
Land	0.8%	19	23
Buildings	9.5%	226	269
Machinery and Equipment	44.1%	1,047	1,249
Total Property, Plant and Equipment	54.4%	1,292	1,541
Accumulated Depreciation	29.7%	705	705*
Net Property, Plant and Equipment	24.8%	589	836

* Based on 2003 asset base.

Based on this analysis of industry statistics, DOE estimates that manufacturing assets (i.e., net property, plant and equipment value) total approximately 24.8 percent of annual revenue. Based on annual revenues of $2.374 billion in the year 2003 the net asset base would total $589 million. These assets would have been acquired at a cost of $1.292 billion dollars. Machinery and equipment represent over 80 percent of the property, plant and equipment assets.

The next subsections illustrate two possible assumptions to estimate stranded assets using current industry statistics, the AHAM data submittal, and investment figures taken from a manufacturing cost assessment of V and H-axis clothes washers. In the first approach it is assumed that the industry cost structure (as a % of revenue) will remain unchanged. The second approach assumes that the total capital requirements (per unit clothes washer) remains unchanged after a new standard. Finally, the manufacturing cost assessment is examined to provide insight as to which of the previous two assumptions is supported by current H-axis manufacturing practice.

11.6.3.1 Assumption 1: Capital Structure (% of Revenue) Remains Unchanged

Table 11.32 describes how the current industry cost structure can be used to estimate future capital requirements. Assuming the capital structure (% of revenue) remains unchanged after a new standard comes into effect, the value of total, property, plant and equipment needed to manufacture clothes washers that are 35 percent more efficient (Trial Standard Level 4) is $1.541 billion.

Hypothetically, a standard that completely obsoletes manufacturer property, plant and equipment assets would result in a write-off of $589 million in 2003 ($1.292 billion less accumulated depreciation). Furthermore, new physical assets would need to be purchased at a cost of $1.541 billion. Of course, this is a worst case scenario. A best case scenario would assume that the pre-standard assets would roll over completely in the post-standards manufacturing processes and thus only $249 million of new assets would be required. By means of comparison, manufacturer's data submittal at the 35 percent efficiency (Trial Standard Level 4) is $631 million, a value closer to the best case.

Table 11.33 illustrates an approach used to estimate the book value of stranded assets in 2004, for Trial Standard Levels 1,2,4, and 5.

Table 11.33 Estimate of Industry Stranded Assets (Assuming Industry Maintains Current Cost Structure) ($million)

Description	Trial Standard Level			
	1	2	4	5
Revenues	$2,489	$2,749	$2,833	$2,844
Pre-standard Property, Plant and Equipment	$1,292	$1,292	$1,292	$1,292
Post-standard Property, Plant and Equipment	$1,354	$1,495	$1,541	$1,547
New Capital Required (Based on new revenues)	$62	$204	$250	$255
AHAM Capital Conversion Costs (AHAM data submittal)	$166	$533	$631	$631
Capital Replaced (Gross Stranded Assets)	$104	$330	$381	$375
NET Capital Write-off (subtract depreciation)	$48	$150	$174	$171
Capital Replaced as % of Pre-standard Property, Plant and Equipment	7.9%	25.1%	29.0%	28.5%

From the above analysis, a standard requiring a 35 percent energy efficiency improvement (Trial Standard Level 4) would obsolete $381 million in assets resulting in an accounting loss of $174 million dollars. Similar analyses yield asset write-offs of $48 million, $150 million and $171 million at efficiency levels of 20 percent (Trial Standard Level 1), 25 percent (Trial Standard Level 2) and 40 percent (Trial Standard Level 5), respectively.

11.6.3.2 Assumption 2: The Per Unit Clothes Washer Capital Requirements Are Unchanged

The analysis summarized in Table 11.33 explicitly assumes that the manufacturing cost structure remains unchanged after a new standard comes into effect (i.e. the value of property, plant and equipment will represent the same percent of annual revenues before and after standards). This may not be the case however. The differential manufacturing cost assessment of baseline and high efficiency clothes washer performed by the Department calculated slightly lower per unit clothes washer investments for H-axis clothes washers compared to V-axis clothes washers despite total production costs which are 60 percent greater for H-axis designs. The higher production cost of H-axis designs was attributed primarily to the much greater value of purchased components. The manufacturing cost assessment summarized in Chapter 5 notes that the investment costs are driven by design choices, manufacturing process selection, and make versus buy decisions. All of these are subject to change if the manufacturing volumes are significantly increased.

From the above observation, another possible assumption for future capital requirements is that for a given manufacturing capacity, industry will maintain its current total value of plant, property and equipment. This is an intermediate assumption that sits squarely between the constant percent revenue assumption and the manufacturing cost assessment result of reduced per unit capital costs. Table 11.34 recalculates the value of stranded assets assuming the absolute value of property, plant and equipment post-standards is the same as the pre-standard value. Given the available information, the values for capital replaced calculated as a percent of pre-standard property, plant, and equipment, are our best estimate of the value of stranded assets.

Table 11.34 Estimate of Industry Stranded Assets (Assuming Industry Maintains Current Value of Plant, Property and Equipment) ($million)

Description	Trial Standard Level			
	1	2	4	5
Revenues				
Pre-standard Property, Plant and Equipment	$1,292	$1,292	$1,292	$1,292
Post-standard Property, Plant and Equipment	$1,292	$1,292	$1,292	$1,292
New Capital Required (Based on new revenues)	$0	$0	$0	$0
AHAM Capital Conversion Costs (AHAM data submittal)	$166	$533	$631	$631
Capital Replaced (Gross Stranded Assets)	$166	$533	$631	$631
NET Capital Write-off (subtract depreciation)	$76	$243	$288	$288
Capital Replaced as % of Pre-standard Property, Plant and Equipment	13%	41%	48%	48%

11.7 IMPACT OF THE EFFECTIVE DATE ON NEW STANDARD

Except for the consensus recommendation, the Industry cash flow Impacts presented in Section 11.3 assume a standard announcement date of late 2000 with the new standard taking effect at the beginning of 2004. This corresponds to the minimum phase-in time required by the legislation. This section analyzes the impact of a longer phase-in period on the industry cash flows. It provides an analytical foundation to the enhancements to the GRIM made necessary by the desire to study the impact of delaying standard implementation dates. Section 11.7.1 discusses the effect of increasing the phase-in time by up to 6 additional years. Section 11.7.2 analyzes the effect of a delay on both dryer and clothes washer repair businesses. GRIM operating principles for a delay in the effective date are discussed in Appendix P.

11.7.1 The Impact of a Delay in the Effective Date on Cash Flow

A delay in the effective date of a new standard can mitigate the cash flow impact of standards in several ways. First, delaying the effective date discounts the net present value of the standards-induced investments. Second, a delay allows more time to plan an orderly transition between existing and future capital requirements in plant, property and equipment. Third, more lead-time increases the opportunity to divert "ordinary" research and development (R&D) towards energy efficiency improvements. Given several additional years of product development, there is a possibility that innovation may result in less costly high efficiency clothes washer designs than currently anticipated.

The following sections detail how the GRIM model was used to estimate the change in Industry cash flows resulting from a delay in the effective date. As described below, the GRIM already captures the effects of discounting. However, additional assumptions and modifications were made to capture the benefits of improved capital and R&D planning. Given the highly speculative nature of forecasting product and process innovation, no attempt is made to quantify this potential benefit.

11.7.1.1 Discounting

The GRIM model captures the time value of money by discounting future cash flows at the Industry's weighted cost of capital adjusted for inflation. For instance, since GRIM cash flows are net of inflation, the capital conversion and product conversion costs are the same regardless of implementation date. Each year the investments are delayed, lowers the NPV of these investments by 6.65 percent.

11.7.1.2 Ordinary Capital Expenditures Assumption

Ordinary capital expenditures are the investments associated with maintaining and replacing existing production assets. In the Base Case the GRIM models ordinary capital expenditures as a percentage of revenues. This percentage value is slightly greater than the value of ordinary depreciation. This allows for maintenance of the Industry's capital stock and factors the growth in assets needed to respond to slowly increasing Industry shipments.

Given a delay in the implementation date, manufacturers can better plan their ordinary capital expenditures and fully depreciate that portion of their production assets that will not be required after the standard. In order to model this effect the following steps were taken:

- The value of "stranded" production assets was estimated for each standard level as detailed in Section 11.6. Stranded assets do not need to be maintained.
- For each delay year, the ordinary capital expenditures in the Base Case were reduced by a factor equal to the percentage of stranded assets.

Table 11.35 summarizes the value of stranded assets and stranded assets as percentage of pre-standard assets as previously described in Table 11.34. These figures are used to reduce ordinary capital expenditures in delay years. It can be observed that at Trial Standard Level 4 (35 percent efficiency improvement), 288 million dollars of current plant, property, and equipment assets are stranded. This value represents 48 percent of the pre-standard assets. To model the potential benefit from a delay, "ordinary" capital expenditures are reduced by this percentage value for the delay years. The GRIM model also allows the user to define stranded assets as a function of revenue consistent with Table 11.33.

Table 11.35 Stranded Assets as a percent of Pre-standard Assets

Efficiency			Stranded Assets	
Trial Standard Level	**Efficiency Level**	**MEF**	**Value of Stranded Assets ($millions)**	**Stranded Assets as a % of Pre-Stranded Assets**
	5%	0.860	0.5	0.1%
	10%	0.908	6.6	1.1%
	15%	0.961	10.6	1.8%
1	20%	1.021	75.9	12.7%
2	25%	1.089	243.2	40.6%
4	35%	1.257	287.5	48.0%
5	40%	1.362	287.5	48.0%

11.7.1.3 R&D Assumption

The design and marketing costs associated with a new standard are very significant. Design costs are costs incurred for the purpose of designing and developing more efficient products and the processes needed for their manufacture. Marketing costs are the expendable costs for new product advertisements, product literature and catalogs, product obsolescence and various related marketing expenses. Table 11.36 summarizes the aggregated design and marketing costs submitted by AHAM.

Table 11.36 Standards-Related Design & Marketing Expenditures

Efficiency			Design & Marketing
Trial Standard Level	**Efficiency Level**	**MEF**	**$millions**
	5%	0.860	1.3
	10%	0.908	7.3
	15%	0.961	12.8
1	20%	1.021	54.8
2	25%	1.089	154.1
4	35%	1.257	179.0
5	40%	1.362	179.0

In the Base Case industry cash flow, it is assumed that industry spends 1.8 percent of annual revenues on the design of new products and manufacturing processes. Assuming Base Case revenues of $2.35 billion in 2002, this amounts to an annual expenditure of $42 million. Additionally, manufacturers spend considerable sums marketing existing and new products. These costs, included in the Base Case SG&A input, can approach the sums spent on R&D.

A delay in the standards phase-in delay allows more time for better integration of the Base Case design and marketing of "ordinary" expenditures. To model these benefits we made the assumption that a delay would allow companies to redirect their ordinary R&D costs towards standard-related marketing and design in each delay year. The magnitude of the redirection is the lower of the standard-related marketing and design value divided by the number of delay years or 50 percent of ordinary R&D.

11.7.2 The Impact of a Delay in Effective Date on Dryer and Clothes Washer Repair Businesses

The impact of a delay on the dryer business is to postpone the reduction in shipments and the associated revenue losses. For the repair business, delaying the implementation date postpones the increase in the number of clothes washer repairs and lowers the NPV gains in the repair business.

11.8 IMPACT ON SMALL MANUFACTURERS

11.8.1 Introduction

During interviews DOE found that basic cost structures among the various manufacturers did vary. Manufacturing large volumes and optimizing production for these levels can create a significant cost advantage. Smaller manufacturers of clothes washers could thus be affected more negatively than other manufacturers by any proposed standard because of their need to spread fixed costs over smaller production volumes.

To assess the potential impacts of possible washer standards on smaller manufacturers, the Department prepared a cash flow analysis of the potential effects on a prototypical smaller manufacturer. Based on this analysis, it appears likely that any standard that necessitates a departure from current basic designs would have substantial negative impacts on smaller manufacturers and could well cause smaller manufacturers to cease producing washers covered by the proposed regulations. However, while the smaller manufacturers may cease to manufacture clothes washers, they may choose to remain in the market by sourcing washers from other producers.

At the time of the manufacturer interviews, the U.S. washer industry had one manufacturer of washers with a production volume of approximately 300,000 units (Alliance Laundry Systems, LLC), most of whose production was supplied to another relatively small appliance company (Amana Appliances) under the terms of a private label supply agreement entered into when the two companies were sold by Raytheon. This agreement ended in September 1999, and Amana announced that it would produce its own vertical-axis washers instead of sourcing them from Alliance. Other specialty niche manufacturers of washers do exist in the United States, but no other smaller company has more than a 1 percent share of washer production.

Amana and Alliance both report that any standard that requires a 25 percent or higher improvement (standard level 2 and above) in energy efficiency would certainly require major investments and the development of a horizontal- axis machine. At this time, neither Amana nor Alliance believes they have a functioning horizontal-axis washer capable of cost-competitively participating in the mass consumer marketplace.

The fundamental challenge for a smaller manufacturer is to manage a major change in washer technology. Converting from the company's current basic product line involves creating a new design, testing it, and moving it into production, with any concomitant capital investments. Smaller manufacturers typically have fewer resources in terms of both engineers and technical facilities than do many of the larger washer producers. Moreover, as previously mentioned, in the specific situation of the washer industry, neither of the two smaller manufacturers has access to horizontal-axis washer designs appropriate for the mass consumer market. Therefore, any standard that forces these companies to make a major change in technology would, at a minimum, force them to make significant investments and could force them to develop a product for which they do not have an existing technical base of experience. This would be a highly uncertain and risky set of circumstances for either company.

One critical issue for smaller companies is their ability to spread the fixed costs of meeting a standard over smaller production volumes, particularly engineering and product-development costs and the necessary investments in plant and equipment. For an industry average firm (assuming approximately a 20 percent market share), these costs (amortized over five years) range from \$.07 per unit at a 5 percent efficiency improvement (MEF= 0.860) to nearly \$25 per unit at 45 percent and 50 percent (MEF=1.634) improvements. At more stringent 45 and 50 percent standard levels, the per-unit cost for a smaller manufacturer could be $20 higher than for the industry average. This difference is likely to result in a significant negative impact on smaller manufacturers since pre-tax profits in the washer industry are currently less than $20 per unit for the average manufacturer and, based on interviews, lower for smaller manufacturers.

Based on composite production-cost data and multiple reports from manufacturers on the costs of product design and production capacity, a company currently producing 300,000 or fewer units per year is likely to lose the majority of its value and could have a negative value if it chose to convert to horizontal-axis technology. For reference, a company that maintains its current company value would earn a market return on its investment. Any company whose value drops below the Base Case is not earning economic returns and companies with a negative company value are probably better off ceasing production than making the conversion investment.

11.8.2 Small Manufacturer Modeling Approach

The basic approach adopted in this report to analyze the economic effects on a smaller manufacturer involves determining the smaller company's fixed cost structure relative to the industry average and the likely ability of the smaller company to recover its full costs and investments after a new standard. For the purposes of a small manufacturer impact analysis, DOE assumed that the Base Case variable cost structure (including labor, materials, and factory overhead costs), which represents the industry average, applies to smaller manufacturers as well. Second, DOE assumed that the final post-standards ex-manufacturer price for washers equilibrates at a level that preserves the value of the company with a 20 percent market share. Finally, to isolate variables, we assumed that market share would remain constant after the introduction of a standard. All three of these assumptions tend to minimize the effects of any potential standard on a smaller manufacturer.

All evidence from the manufacturers, and the basic tenets of economic theory, indicate that the actual cost structure for a smaller company in the appliance industry will be higher, on a percentage of revenue basis, than the cost structure for a larger company. Larger volumes allow larger firms to secure better terms from suppliers, reducing their costs and improving their competitive position and ability to absorb additional fixed costs. Therefore, this analysis which assumes that a smaller company has a baseline cost structure that parallels the industry average overstates the initial value of the company and understates the effects of any regulations.

11.8.2.1 Price Assumption

Small manufacturers, with equivalent market share, have relatively little market power and so cannot affect market prices. They must accept the prices imposed by the larger players. Small manufacturers cannot increase their prices to recoup their investments unless the larger manufacturers succeed in doing so themselves. The exceptions to this are if they accept a loss in market share (which they can ill afford due to the importance of volumes in spreading fixed costs) or if they have a niche product with features that consumers value and are prepared to pay a higher price for.

The assumption for the final washer prices in a post-regulation scenario is based on the cost structure for a participant with a 20 percent market share. This is a company whose costs approximate the industry average and, therefore, is a logical choice for modeling pricing equilibrium. The price that generates a market rate of return on standards induced investment is likely to be, for a firm with industry average costs, the maximum price achieved in the marketplace. Actual competitive conditions, however, may cause manufacturers to compete more vigorously, pushing down prices from this level.

11.8.2.2 Shipments Assumption

Based on the Department's shipment forecasts, shipments will decline initially for any standard that leads to a significant increase in washer prices. The shipment forecasts used for small manufacturers assume a constant market share before and after standards. The market share values are 2.1 percent for small manufacturer 1 and 4.2 percent for small manufacturer 2. Table 11.37 illustrates base year shipments of V and H-axis washers for each manufacturer.

Table 11.37 Base Year Shipments

Shipment Scenario	Small Man 1 (2.1%) V-Axis	Small Man 1 (2.1%) H-Axis	Small Man 2 (4.2%) V-Axis	Small Man 2 (4.2%) H-Axis	Large Man (20%) V-Axis	Large Man (20%) H-Azis
High Price	151,900	15,100	303,700	30,100	1,446,400	143,500
Med Price	150,800	15,000	301,500	29,900	1,435,900	142,500
Med P/I	151,500	15,000	303,000	30,100	1,442,900	143,200

11.8.2.3 Product Conversion Cost Assumption

The costs to design, test and introduce a new technology have a significant fixed component. It does not cost a company with four times the volume four times as much to develop a product because much of the engineering and testing are a function of the number of models rather than the production volume. In most manufacturing industries, companies with larger volumes tend to have more extensive engineering organizations, do more testing and investigate more potential options to enhance their products or reduce their manufacturing costs. Based on the Department's discussions with washer manufacturers and the manufacturer's estimates of their own development costs, 15 to 25 percent of the engineering cost of the average sized firm is fixed, implying that a small manufacturer will spend at least this fraction of the large manufacturer's engineering costs.

11.8.2.4 Capital Investment Assumption

Plant and equipment investments are inherently more variable than engineering costs. Nevertheless, there is a fixed component to production engineering and to building the plant facilities and there are minimum volumes for efficient production lines. Beyond these fixed costs, production related investments are largely variable based on the number and capacity of the production lines necessary to meet the anticipated volumes.

Again, based on discussions with washer manufacturers, 10 to 20 percent of the capital investment requirements for the average sized firm are fixed.

11.8.2.5 Summary of Key Assumptions

In order to determine the financial effects on smaller manufacturers of a significant shift in washer technology, DOE estimated the company value for a smaller manufacturer using the GRIM and the following assumptions:

- Base Case V-axis production volume of approximately 300,000 units in 2004, approximately equal to the past volume of Alliance's production, with a sensitivity of approximately 150,000 units in 2004. These production volumes correspond to V-axis market shares of 4.2 percent and 2.1 percent respectively. These market shares are used to scale industry shipments for the Base Case and Standard Case shipments.
- Total costs for engineering and investments for capital conversion as reported by AHAM.
- Fixed percentages of engineering and capital (15 percent for capital investment and 20 percent for engineering) based on interviews with manufacturers.
- Labor, material and overhead costs equal to the overall industry levels as submitted by AHAM. All other assumptions from the Base Case industry GRIM analyses.
- Ex-manufacturer prices based on industry levels.

The results of the smaller company GRIM analysis are shown in Tables 11.38 through 11.40. These results represent the change in millions from Base Case NPV to Standard Case NPV.

Table 11.38 Change in Value of Small Manufacturers, Results for the "No Consolidation" Scenario - High Price Elasticity Scenario (%)

Trial Standard Level	MEF	Large Manufacturer (20% Market Share)	Small Manufacturer (4.2% Market share)	Small Manufacturer (2.1% Market share)
1	1.021	(1.9)-(6.9)	(18.1)-(23.0)	(38.5)-(43.4)
2	1.089	(30.5)-(41.0)	(80.1)-(90.6)	(142.8)-(153.4)
3	1.04 in 2004 1.26 in 2007	(34.4)-(41.4)	(86.2)-(93.3)	(151.9)-(158.9)
4	1.257	(39.3)-(45.9)	(93.2)-(99.8)	(161.3)-(167.9)
5	1.362	(35.7)-(40.3)	(89.4)-(94.0)	(157.4)-(162.0)
6	1.634	(39.4)-(50.0)	(93.1)-(103.8)	(161.1)-(171.8)

Table 11.39 Change in Value of Small Manufacturers, Results for the "No Consolidation" Scenario - Medium Price Elasticity Scenario (%)

Trial Standard Level	MEF	Large Manufacturer (20% Market Share)	Small Manufacturer (4.2% Market share)	Small Manufacturer (2.1% Market share)
1	1.021	(1.3)-(6.2)	(17.4)-(22.4)	(37.9)-(42.8)
2	1.089	(28.2)-(39.0)	(78.9)-(89.8)	(143.1)-(153.9)
3	1.04 in 2004 1.26 in 2007	(28.6)-(36.0)	(83.1)-(90.6)	(152.2)-(159.6)
4	1.257	(34.4)-(41.5)	(91.8)-(98.9)	(164.4)-(171.6)
5	1.362	(30.4)-(35.4)	(87.7)-(92.7)	(160.3)-(165.3)
6	1.634	(31.2)-(43.3)	(90.7)-(102.8)	(166.0)-(178.1)

Table 11.40 Change in Value of Small Manufacturers, Results for the "No Consolidation" Scenario - Medium Price/Income Elasticity Scenario (%)

Trial Standard Level	MEF	Large Manufacturer (20% Market Share)	Small Manufacturer (4.2% Market share)	Small Manufacturer (2.1% Market share)
1	1.021	(0.9)-(5.9)	(17.1)-(22.1)	(37.6)-(42.6)
2	1.089	(26.9)-(38.0)	(78.3)-(89.4)	(143.2)-(154.4)
3	1.04 in 2004 1.26 in 2007	(25.9)-(33.7)	(82.1)-(89.8)	(153.2)-(160.9)
4	1.257	(31.4)-(38.9)	(90.9)-(98.4)	(166.2)-(173.7)
5	1.362	(27.2)-(32.5)	(86.7)-(92.0)	(162.0)-(167.2)
6	1.634	(26.6)-(39.6)	(89.4)-(102.4)	(168.8)-(181.8)

11.8.3 Summary of Results

The changes in value for the large company and for the smaller companies in Tables 11.38 through 11.40 illustrate how the inability to spread fixed costs over production volumes can negatively impact the small manufacturers' value.

The results possibly understate the situation for the smaller manufacturers because they assume that labor, materials, and overhead costs for the smaller manufacturers equal the industry average. In reality, small manufacturers production costs are greater than the industry average, which would tend to reduce both their Base Case and their post-regulatory company values.

The decision by either of the smaller producers, or any other washer manufacturer, to exit washer production would require an assessment of the linkages with their dryer business and with other appliances. Manufacturers and their retail partners generally perceive some value in being a full-line producer and greater value in producing both washers and dryers. If a manufacturer perceived significant value in its dryer businesses and if the total product line generated acceptable rates of return, it might continue to produce washers, even in the face of declining company values due to investment in new washer technology. Based on the major loss in company value associated with meeting a Trial Standard Level of 2 and above (25 percent energy savings or more), it is likely that one or both of the two smaller companies would cease to produce washers covered by the standard and might also cease to market them.

11.8.4 Other Impacts

Beyond the evaluated cash flow impacts, smaller manufacturers face a number of other challenges. Small manufacturers may find it difficult, relative to the larger manufacturers, to raise the capital necessary to make the investments required for meeting the new efficiency standards. This impacts small manufacturers' ability to achieve a seamless transfer to a new technology platform. Moreover, because of a lack of economies of scale, smaller manufacturers may be unable to achieve cost reductions when introducing new manufacturing processes.

11.9 EMPLOYMENT IMPACTS

The impact of new energy efficiency standards on employment is an important consideration in the rule making process. In order to assess how domestic employment patterns might be affected by new energy efficiency standards for clothes washers, the Manufacturer Interview Guide was used to explore current trends in clothes washer production employment and solicit manufacturer views on changes in employment patterns resulting from new energy efficiency standards. The employment impacts section of the interview guide was used to understand:

- Current employment levels associated with clothes washer manufacturing at each production facility
- Expected future employment levels both with and without a clothes washer standard
- Differences in workforce skills, and issues related to retraining of employees

In order to maintain confidentiality, employment impacts were aggregated and reported at the industry level.

The weight of available evidence does not support a conclusive assessment of the impact that new energy efficiency standards would have on employment levels. The data that is available is extremely variable and the true extent of the impact will be largely dependent on whether manufacturers choose to exit the industry or move to non-domestic production facilities.

During the course of the interviews, most manufacturers indicated that they believed any increase in efficiency standards that affected the competitive environment of the clothes washer industry would have a negative impact on industry employment levels. Manufacturers indicated that there is some correlation between employment levels and production volumes. While the relationship is not strictly linear, a decline in volume would nevertheless result in a decline in employment levels. In addition, should margins decline, as expected, manufacturers maintained that there would be increased pressure on cost reduction, which could result in further reductions in overhead employment levels. This impact would be exacerbated should the cost pressure be such that it forces firms to exit the industry.

Table 25 illustrates the "worst case" manufacturer implied impact of new energy efficiency standards on employment levels in the clothes washer industry. This assumes the industry suffers the full effect of the partial or full closure of operations relating to residential clothes washer or clothes washer components manufacturing or firms exiting the industry as a result of the new standards. Of note, in Table 11.41, at Trial Standard Level 4 and above (35 percent improvement level or greater), the manufacturer's implied impact is a 25.6 percent decline in total industry employment levels (driven primarily by the possible exit of one or more firms from the industry).

Table 11.41 "Worst Case" Manufacturer Implied Impact of New Energy Efficiency Standards on Employment Levels resulting from Plant Closures*

MEF	0.817	0.961	1.021	1.089	1.257
Impact on total Industry Employees	Approx 9,300	-250	-550	-1580	-2380
# Manufacturers in Industry	6	6	6	5	4-5

Source: DOE Interviews of U.S. Clothes Washer Manufacturers
*This table considers only employees at those facilities in the U.S. and Mexico that produce washers or washer components for the U.S. home laundry market

However, while these numbers approximate the employment impact on current manufacturers, total employment based on shipment volumes may more accurately reflect the impact on the industry as a whole. While reductions in shipments may indeed lead to reductions in employment at various manufacturers due to the full or partial closure of related manufacturing facilities, any reductions from firms exiting could be matched by increased employment in U.S. plants at those firms picking up this additional market share and volumes. In addition, the manufacturers' data supplied to AHAM indicates that incremental labor-related costs are expected to increase at the various efficiency levels, due to the increased complexity of production and assembly of more efficient machines.

Table 11.42 illustrates the manufacturer's estimated incremental labor costs. Using this data, and the shipment data, an estimated impact on employment levels can be implied that reflects changes in employment levels based on the volume of production in the industry. Figure 11.4 illustrates the expected impact on employment levels based on industry shipments and using labor expense as a proxy for labor levels.

Table 11.42 Expected Incremental Labor Costs at Various Efficiency Levels

Trial Standard Level	Efficiency Level	MEF	Incremental Labor Cost ($ per machine)	Total Labor Cost ($ per machine)
Baseline	Baseline	0.817	0	29.3
	5%	0.860	0.01	29.31
	10%	0.908	0.04	29.34
	15%	0.961	0.10	29.40
1	20%	1.021	(0.02)	29.28
2	25%	1.089	8.61	37.91
4	35%	1.257	10.94	40.24
5	40%	1.362	15.52	44.82
6	50%	1.634	15.68	44.98

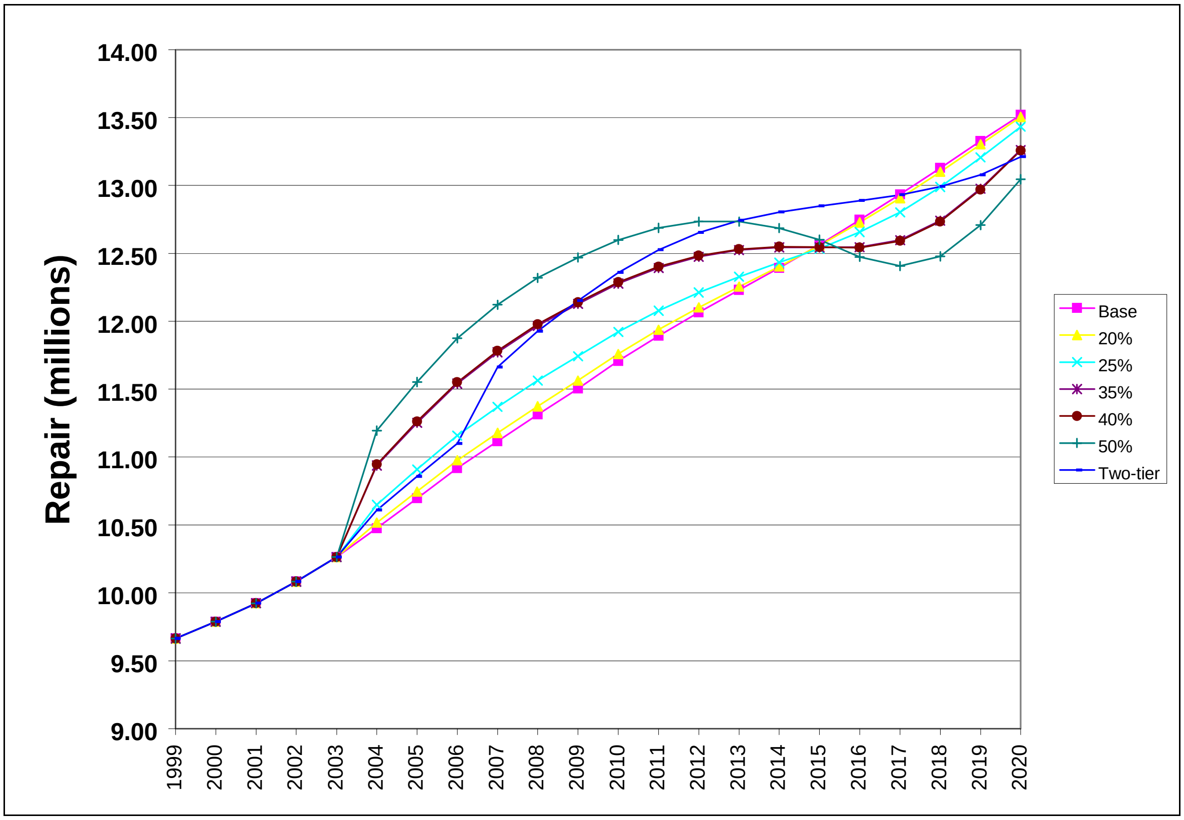

Figure 11.5 Predicted Impact on U.S. Clothes Washer Industry Employment Levels
Source: AHAM Data Submittal, DOE Analysis

Figure 11.4 illustrates predicted changes in overall industry employment levels at various Trial Standard Levels under "best case" assumptions. Changes in employment levels are calculated as a function of total shipments, as forecasted in the NES, and incremental increases in labor expense, at the various standard levels. The results show that employment will track shipments and actually increase due to the incremental increase in labor required for more efficient machines. This does not, however, take into effect the impact of plant closures nor of firms exiting the industry or moving production offshore. It assumes domestic manufacturing facilities maintain their dominance of the U.S. market and that any loss of jobs resulting from plant closures is compensated for by a corresponding increase in employment at another domestic production facility.

All the above arguments have some validity, which makes it extremely difficult to accurately assess the impact of new efficiency standards on industry employment levels. The clearest conclusion is that the real impact on employment levels will be felt if standards are such that manufacturers choose to exit the industry or move domestic production facilities outside the U.S. in an effort to reduce incremental labor costs associated with more efficient machines.

Finally, it should also be noted that as washer sales are correlated with dryer sales, employment levels in the clothes dryer industry may also be impacted by changes to the clothes washer standards. This impact is quantified in Section 11.4 entitled "Impact on Clothes Dryer Business."

11.9.1 Impact on Workforce Skills Required Under New Energy Efficiency Standards

The majority of manufacturers indicated that no extensive retraining would be required for a shift toward a different platform technology as a result of changes in the energy efficiency standards. Any changes/training would be job specific to particular manufacturing positions or research positions (e.g., technical knowledge of H-axis design in R&D). There would be no changes in corporate or associated manufacturing support activities (such as welding, painting, etc.).

11.10 CUMULATIVE REGULATORY BURDEN

While any one regulation may not impose a significant burden on manufacturers, the combined effects of several impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden.

Companies that produce a wider range of regulated products may be faced with more capital and product development expenditures than their competitors. This can prompt those companies to exit one or more markets or reduce their product offerings, potentially reducing competition. Smaller companies can be especially hard hit since they have lower sales volumes over which to amortize the costs of meeting new regulations. If multiple regulations drain the resources of companies across an industry, industry value can be reduced. That can make the industry more susceptible to foreign competition and reduce the attractiveness of investing in the sector.

DOE considers that a proposed standard is not economically justified if it contributes to an unacceptable cumulative regulatory burden.

11.10.1 Regulations on Other Products Produced by Clothes Washer Manufacturers

In addition to the efficiency regulations DOE imposes on clothes washers, clothes washer manufacturers typically produce other appliances, some of which face regulations of their own. For instance, many clothes washer manufacturers will be impacted by recently published minimum efficiency standards for refrigerator/freezers and room air-conditioners. DOE also plans to reassess efficiency standards for central air conditioners, clothes dryers, and residential furnaces-products produced by some clothes washer manufacturers. Additionally, most manufacturers are facing regulations from other agencies. The most significant of these are the Environmental Protection Agency (EPA)-mandated phase-outs of Hydrochlorofuorocarbons (HCFCs). Table 11.43 provides the timetables for some key Federal regulations.

Table 11.43 Future Regulations Affecting Appliance Manufacturers

Regulation	Affected Appliances	Effective Date
DOE ban on the manufacture and import of products that exceed maximum energy use criteria	Room air conditioners Refrigerators/freezers Central air conditioners (residential)	October 1, 2000 July 1, 2001 2006*
EPA ban on the manufacture and import of HCFC-141b (blowing agent)	Refrigerators, freezers, and water heaters	January 1, 2003
EPA ban on the manufacture and import of equipment using HCFC refrigerants	Room and central air conditioners (HCFC-22)	January 1, 2010
EPA standards on emissions of allowable hazardous air pollutants from the coating of large appliances (NESHAP/MACT standards, Clean Air Act Section 112(d))	Clothes washers and dryers, central air conditioners, refrigerators, freezers, furnaces	November 15, 2003*

* Tentative

The above regulations can significantly affect the other product lines of clothes washer manufacturers. Table 11.44 lists the market shares of clothes washer manufacturers in the products that face the regulations listed in Table 11.43. Because of the extensive manufacturer overlap in the production of both refrigerators and clothes washers, regulations affecting refrigerators, including the HCFC-141b ban and the efficiency standards, will have a direct effect on the clothes washer industry.

Table 11.44 Market Shares of Major Clothes Washer Manufacturers in Other Products Faced with Future Regulations

Manufacturer	Clothes Washers	Refrigerators	Freezers	Room Air Conditioners	Central Air Conditioners
Whirlpool	52	26		20	
Maytag	19	10			
General Electric	17	35			
Electrolux/Frigidaire	7	19	75	20	
Goodman/Amana	5	9		7	19
TOTAL	**100**	**99**	**75**	**47**	**19**

Source: Appliance, September 1998.

Table 11.44 also illustrates how broadly regulations affect some companies. Amana and Frigidaire, in particular, derive revenues from many appliances that are subject to Federal regulation. Cumulative regulatory burden can be particularly acute for these companies and can raise concerns over the continued viability of one or more of their product lines.

Table 11.45 indicates the level of impacts that the clothes washer industry may face due to other regulations. The uncertainty surrounding these values is high for several reasons. First, manufacturer impacts depend largely on the company's ability to pass conversion costs through to consumers. Second, information on capital expenditures, R&D, and other conversion costs and project plans are usually considered confidential. Third, companies may be able to incorporate regulatory-driven expenditures into other product development or process improvement efforts.

Table 11.45 Estimated Impacts of Approaching Regulations on Clothes Washer Manufacturers

Regulation	Estimated Impact (million)	Measure of Impact and Source of Data
Refrigerator/freezer efficiency standards	$500 $200	Conversion costs from DOE rule-making analysis Reduction in industry net present value from the Joint Comments on the DOE rule (EE-RM-93-801)
HCFC-141b phaseout	$50	Conversion cost estimate based on manufacturer interviews (assuming transition to 245fa)
Room air conditioner efficiency	$60 $4	Conversion cost estimate based on manufacturer interviews Conversion costs from DOE Room Air rule-making analysis
MACT standards	N/A	(Information not available)
HCFC-22 phaseout	N/A	(Information not available)

The most significant regulation facing the clothes washer industry appears to be the DOE refrigerator/freezer efficiency standard that goes into effect July 1, 2001. Manufacturers are currently making or have already made the investments required to meet the new standard.

Even though no cost information is available for either the HCFC-22 phaseout or the Maximum Achievable Control Technology (MACT) standards, both are likely to have significant impacts. Depending on the alternative refrigerant the market selects, the HCFC-22 phaseout could cause air conditioner manufacturers to undergo complete product redesign and retooling. Depending on each manufacturer's current coating process, the MACT standards could require manufacturers to reformulate their coatings or completely replace their coating facilities and processes. In EPA's preliminary study, none of the six clothes washer facilities attained the recommended MACT requirements, and half exceeded the requirements by more than 400 percent. Three refrigerator plants also exceeded the recommended MACT standards by a substantial margin. One manufacturer anticipates spending over $50 million to comply with the pending MACT standards.

11.10.2 Other Regulations

In addition to the regulations described above, clothes washer manufacturers have identified other regulations that concern them. One example is the DOE appliance test procedures. New test procedures can prompt product redesign and investments in testing apparatus. DOE is revising its test procedures for several products, including residential central air conditioners. DOE has currently assigned a low priority to new test procedures for some other appliances that clothes washer manufacturers produce: clothes dryers, HID lamps, refrigerators, room air conditioners, and small electric motors.

Other potential regulations facing the clothes washer industry manufacturers include international mandates on recycling, Federal Communications Commission (FCC) radio interference regulations on microwave ovens, product safety standards, and EPA regulations on water discharge and pretreatment.

11.11 IMPACT ON SUPPLIERS

The majority of manufacturers indicated that any change in standards that results in the industry shifting to H-axis technology from V-axis technology will have a significant impact on U.S. suppliers of washing machine components and raw materials.

Manufacturers that already produce H-axis washers in the U.S. source primarily from overseas suppliers for H-axis technology-specific components, as these suppliers have much greater experience in this technology. One manufacturer stated that over half the components used in H-axis machines are sourced from overseas suppliers. If the industry were to shift to solely H-axis technology, manufacturers believe that this would significantly alter the ratio of foreign to U.S. suppliers that currently exists in the industry. While U.S. suppliers of components may become competitive over time, there is likely to be a definite shift to overseas suppliers in the short term and once these relationships are established they provide considerable leverage to the incumbent.

Table 11.46 shows that for the typical H-axis machine, a significantly larger percentage of total material costs is from foreign purchased parts relative to that of the typical V-axis clothes washer, indicating that the emphasis on purchasing clearly shifts to foreign purchased parts.

Table 11.46 Average Breakup of Raw Materials and Component Costs in U.S Manufactured Clothes Washers (as % of Total Materials Cost)

	Typical V-axis	Typical H-axis
% Domestic Purchased parts	21-55%	30-40%
% Foreign Purchased Parts	6-13%	38-42%
% Raw Materials	39-66%	22-28%

Source: DOE Reverse-Engineering Analysis of current U.S. manufactured clothes washers

Manufacturers also stated that while sheet metal, plastic, paint and other raw materials would most likely still be sourced from the U.S., two other factors must be considered relating to raw material suppliers. First, if there is a decline in the volume of clothes washers shipments, as most analyses indicate, this will have a commensurate impact on raw material requirements. Manufacturers indicated that there is no substantial incremental increase in the use of raw materials with a shift from V-axis machines to H-axis. As illustrated in Table 11.46, this view was supported by DOE's reverse-engineering analysis of current U.S. manufactured clothes washers.

Second, if the industry shifts to H-axis and manufacturers shift to increased sourcing of components from overseas suppliers, then once such a disruption in the supply chain occurs, manufacturers are likely to look to overhaul the entire supply chain process. This may result in some manufacturers looking to source even the raw materials from the cheapest overseas sources. Manufacturers stated that such a shift has already occurred in room air conditioners.

Another factor to consider is the fact that some manufacturers and suppliers have already invested heavily in forging close partnerships. Any change that impacts the manufacturer/supplier relationships will have an enhanced effect in such cases and impact both the supplier and the manufacturer. As an example, only recently one manufacturer carried out a major redesign of its clothes washer platform and used this opportunity to re-evaluate its manufacturing operations, eventually deciding to source assembled components from its suppliers. It made significant investments in building relationships with suppliers in the vicinity and actively helped them upgrade their facilities. In some cases, suppliers built whole new plants to support the manufacturer's clothes washer component requirements. Some employees even transferred from the manufacturer to the suppliers, as the suppliers assumed some of the manufacturing activities. To manufacturers that have a high level of integration with their suppliers and have invested in their production capabilities, disruption in their suppliers' production processes would be particularly significant.